DESIGNS FOR ENERGY EFFICIENT HOUSING
IN NORTHERN MANITOBA

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LIST OF DELIVERABLES (Under Separate Cover)

- 2 house models (3/4" = 1'-0")
- 4 house models (3/8" = 1'-0")
- 2 model wall sections (half scale)
- 1 slide presentation
- 1 set of construction drawings, bills of materials and current (March, 1985) prices for each of the 14 designs.

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EXECUTIVE SUMMARY

The provision of housing on Indian Reserve communities is an urgent priority both for Indian organizations and the Federal Government (as represented by EMR, DIAND and CMHC) alike. As energy costs rise there will be an increasing need to construct well-designed, energy-efficient housing for Manitoba's remote Indian communities.

As a first step towards tackling the problem the Manitoba Keewatinowi Okimakanak Inc. (MKO) submitted a proposal for a programme consisting of two phases. Phase I is to design examples of more appropriate energy-efficient housing for the remote communities which fall under the jurisdiction of the MKO that is within the budget allotments available from DIAND and CMHC. Phase II will be to build the newly designed houses on a demonstration basis in a number of the new communities, and to develop an educational programme to promote the new designs and to teach techniques for constructing energy-efficient housing.

Phase I, in turn, is subdivided into three stages. Phase I was undertaken in such a way to ensure maximum involvement by the communities and the MKO. The first is the **Background Review Stage**, where the current housing designs, construction practices and the administrative problems and industrial benefits of delivering energy-efficient housing in the north were documented. The Design Team visited two of the four communities as part of the Background Review. In the **Preliminary Design, Stage 2**, the Design Team prepared a series of concept plans for presentation to the four remote communities of Brochet, Lac Brochet, Pukatawagan and Tadoule Lake. The designs were then revised and a full set of 14 house designs were presented again to the four communities in the **Final Design, Stage 3**. The designs, while energy efficient, could not be done according to the Arctic Housing Standards because the current DIAND and CMHC housing budget guidelines do not permit the additional expenditure on extra energy conservation features.

The designs included bungalows, bi-level and 2 storey forms. They are listed as follows:

- Bungalow Plans
  1. 24' x 36' Plan "A" (3 bedroom)
  2. 24' x 36' Plan "B" (4 bedroom)
  3. 24' x 36' Plan "C" (3 bedroom)
  4. 24' x 28' Plan "A" (2 bedroom)
  5. 24' x 28' Plan "B" (2 bedroom)
  6. 24' x 28' Plan "C" (3 bedroom)
  7. 24' x 32' (3 bedroom)
  8. 24' x 40' (4 bedroom)
- Bi-level Plans
  1. 18' x 26' Plan "A" (3 bedroom)
  2. 18' x 26' Plan "B" (4 bedroom)
  3. 24' x 32' (6 bedroom maximum)
- 2 Storey Plans
  1. 16' x 28' (4 bedroom)
  2. 18' x 26' (4 bedroom)
  3. 20' x 24' (1 3/4 storey 4 bedroom)

The Phase I deliverables consist of this report on the project; 14 sets of house designs with construction details; bills of materials and current (March 1985) prices; two house models; model wall sections; a slide presentation; and the Background Review Stage report.

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PLANS D'HABITATIONS À HAUT RENDEMENT ÉNERGÉTIQUE POUR LES COLLECTIVITÉS DU NORD DU MANITOBA

Résumé

Fournir des logements aux habitants des réserves indiennes est à la fois urgent et prioritaire autant pour les organisations indiennes que pour le gouvernement fédéral (représenté par EMR, AINC et la SCHL). Les coûts de l'énergie ne cessant d'augmenter, il faudra de plus en plus construire des maisons de bonne conception et à haut rendement énergétique pour les collectivités amérindiennes éloignées du Manitoba.

Pour faire face à cette situation, la Manitoba Keewatinowi Okimakanak Inc. (MKO) a proposé en premier lieu de mettre en oeuvre un programme à deux phases. La première consiste à concevoir des habitations à haut rendement énergétique plus appropriées aux communautés éloignées relevant de la MKO, soit dans les limites des affectations de crédits prévues par les budgets d'AINC et de la SCHL. La seconde consiste à construire dans certaines réserves des maisons modèles à partir des nouvelles conceptions et d'élaborer un programme éducatif destiné à faire connaître les nouveaux concepts de construction et à enseigner les techniques nécessaires pour construire ces habitations à haut rendement énergétique.

La première phase qui est conçue de façon à faire appel à une participation maximale des collectivités et de la MKO se divise en trois étapes. La première est celle de la révision de la situation, au cours de laquelle on a rassemblé les renseignements relatifs aux plans de maisons actuels, aux méthodes de construction ainsi qu'aux problèmes administratifs et aux avantages industriels liés à la construction de maisons à haut rendement énergétique dans les régions nordiques. Dans le cadre de cette révision, l'équipe chargée de la conception a visité deux des quatres collectivités visées. À l'étape de la conception préliminaire, la deuxième, l'équipe chargée de la conception a préparé une série de plans, qu'elle a présentés aux quatre collectivités éloignées de Brochet, Lac Brochet, Pukatawagan et Tadoule Lake. Après avoir révisé ces plans, l'équipe a mis au point un jeu complet de 14 plans de maisons qu'elle a présentés aux quatre collectivités dans le cadre de la troisième étape de la première phase: la conception finale. Ces plans, bien que misant sur le rendement énergétique ne pouvaient pas être réalisés conformément aux Normes des habitations de l'Arctique puisque les lignes directrices d'AINC et de la SCHL régissant le budget en matière de logement ne permettent pas de dépenses supplémentaires au chapitre des éléments ajoutés pour économiser de l'énergie.

Les types de maisons visées par les plans comprenaient les maisons de plain-pied, à deux niveaux et à deux étages dont voici la liste:

- Plans de maisons de plain-pied (Voir "Bungalow plans")
  1. Plan "A" de 24 pi x 36 pi (3 chambres à coucher)
  2. Plan "B" de 24 pi x 36 pi (4 chambres à coucher)
  3. Plan "C" de 24 pi x 36 pi (3 chambres à coucher)
  4. Plan "A" de 24 pi x 28 pi (2 chambres à coucher)
  5. Plan "B" de 24 pi x 28 pi (2 chambres à coucher)
  6. Plan "C" de 24 pi x 28 pi (3 chambres à coucher)
  7. 24 pi x 32 pi (3 chambres à coucher)
  8. 24 pi x 40 pi (4 chambres à coucher)

- Plans de maison à deux niveaux (Voir "Bi-level plans")
  1. Plan "A" de 18 pi x 26 pi (3 chambres à coucher)
  2. Plan "B" de 18 pi x 26 pi (4 chambres à coucher)
  3. 24 pi x 32 pi (6 chambres à coucher au maximum)

- Plans de maisons à deux étages (Voir "Two-storey plans")
  1. 16 pi x 28 pi (4 chambres à coucher)
  2. 18 pi x 26 pi (4 chambres à coucher)
  3. 20 pi x 24 pi (1 3/4 étage, 4 chambres à coucher)

Les produits à livrer relatifs à la phase I sont le présent rapport, un jeu de 14 concepts différents de maisons, y compris les détails de construction, des listes de matériaux et des prix courants (mars 1985); deux maquettes de maisons et de modèles de coupes de mur, un diaporama et le rapport de l'examen de la situation.

Chacune des trois étapes de la Phase I est expliquée ci-dessous:

1.1.1 Revision de la situation

Le but de cette revision était de réexaminer la situation qui prévalait au plan administratif, économique, architectural et de l'ingénierie dans le domaine de l'habitation à haut rendement énergétique pour les collectivités nordiques. Il ne faisait aucun doute que cette revision était nécessaire. D'une part, l'équipe de concepteurs de Appin/UNIES ne voulait pas créer des plans qui ne seraient pas admissibles aux programmes de financement du gouvernement. D'autre part, cela ne servait à rien de répéter les erreurs de génie ou d'architecture faites par le passé, ou de ne pas profiter des derniers progrès en matière de technologie de l'habitation. Il était nécessaire de tenir compte des réalisations antérieures pour progresser. Le fait de résumer ces réalisations dans l'étape de la revision de la situation constituait un moyen de s'assurer que tout avait été entrepris dans le but de tirer avantage des connaissances acquises dans le domaine. Par la suite, l'équipe de concepteurs est allée visiter les collectivités éloignées.

1.1.2 Conception préliminaire

À l'étape de la conception préliminaire, l'équipe de concepteurs a dessiné les plans de prototypes de maisons chauffées au bois. Ces plans ont été transformés en maquettes et en croquis architecturaux. L'équipe de concepteurs a produit une série de plans de charpente de maison de plein-pied, à deux niveaux et à deux étapes ainsi que des plans modifiés de la charpente en A. Tous ces plans sauf celui de la charpente en A furent approuvés par les collectivités. Des modèles de coupes de mur furent construits pour illustrer les détails de la construction. Les plans pouvaient ainsi être soumis aux collectivités afin qu'elles puissent faire part de leurs commentaires.

1.1.3 Conception finale

Lors de la conception finale, les plans devaient être modifiés en fonction des commentaires reçus, pour être présentés une fois de plus aux collectivités. Une approche qui supposait l'action réciproque et continue des collectivités et des concepteurs était la clé de l'élaboration de plans de maisons réalisables. Le rapport final devait inclure les plans, les détails de construction, un résumé des travaux de génie à accomplir et finalement, une série de recommandations pour la construction des maisons.

1.1.4 Mise en oeuvre de la Phase II

Une fois la Phase I terminée, il était prévu qu'une seconde phase aurait lieu au cours de laquelle les maisons conçues seraient construites pour fins de démonstration dans les collectivités éloignées. Il était aussi à espérer que des menuisiers amérindiens de l'endroit seraient former à la construction de maisons à haut rendement énergétique. Grâce à cette approche à phases multiples, des maisons à haut rendement énergétique seraient conçues et soumises à des essais et le savoir-faire nécessaire à la construction de ces maisons seraient transmis à la population locale de ces collectivités.

Cette étude a été effectuée par Appin/Unies pour le MKO à l'aide d'une subvention des Affaires indiennes et du Nord Canada et du Programme de démonstration dans les collectivités éloignées d'Energie, Mines et Ressources Canada.

VOLUME 1 - BACKGROUND REPORT

I INTRODUCTION

The problems of inadequate housing on northern Manitoba are well known to Indian People and governments alike. While much effort has been made in the past to provide Indian housing, there still remains a lot to be done to satisfy reserve housing needs.

The Manitoba Keewatinowi Okimakanak, Inc. and the Federal Government both recognize that housing needs for reserve communities will continue to increase as reserve populations grow. Shelter is a high priority and developing better quality, energy efficient housing is one way of helping to reduce the current housing backlog that exists on reserves in northern Manitoba.

1.1 Study Rationale

To meet this growing need to improve housing in the north for Indian People, the MKO together with the Federal Government Departments of Energy Mines & Resources (EMR), Indian Affairs & Northern Development (DIAND) and the Canada Mortgage & Housing Corporation (CMHC) commissioned the firms of Appin Associates & UNIES Ltd. to design more appropriate energy efficient housing for Manitoba's remote communities. The project is divided into three stages, namely:

- A Background Review Stage
- A Preliminary Design Stage
- A Final Design Stage

The purpose of the Background Review Stage and the subject of this report is to review the administrative/economic, architectural and engineering issues in energy efficient/northern housing. The need for such a review is clear. The Appin/Unies Design Team does not want to develop designs which do not fit with government programs. It makes no sense to repeat past engineering or architectural design mistakes or not to take advantage of latest advances in housing technology. One needs to build on this previous collective experience. Summarizing this experience in this document is one way of ensuring that every effort is made [illegible] take advantage of previous knowledge.

1.2 Organization of this Background Review Report

The report is organized into five chapters, the contents of which are as follows.

Chapter II contains a review of the administrative and economic issues relating to the provision of energy efficient housing in northern Manitoba. This chapter was prepared prepared by Appin Associates.

Chapter III summarizes previous housing design efforts undertaken in the past. This chapter was prepared by Appin Associates.

Chapter IV was prepared by UNIES Ltd. and outlines the engineering design issues as it relates to northern energy efficient housing.

Finally, there is an executive summary that summarizes the findings from the previous studies reviewed and then the chapter outlines directions and concerns to be addressed in the house design to be prepared by the Appin/UNIES Team. It is included in this report and is also issued separately for wider circulation.

II REVIEW OF ADMINISTRATIVE AND ECONOMIC ISSUES RELATING TO THE PROVISION OF ENERGY EFFICIENT HOUSING IN THE NORTH

This chapter outlines the issues relating to the delivery of housing from an administrative perspective. The chapter also summarizes the economic and industrial benefits of providing housing in northern Manitoba. The reason for this analysis is to show the limitations that administrative and financial constraints can place on designs for housing. On the other side, there may be industrial and economic benefits that can flow from the provision of housing in the north. These benefits can come in the form of increased Indian participation in the supply of labour and materials for the housing.

2.1 A Summary of the Major New Housing Construction Programs Used on Indian Reserves

There are two major programs used on Indian reserves, namely:

- The DIAND Band Capital Housing Program (DIAND)
- The CMHC 56.1 Non-Profit Housing Program

In addition, Bands can use the Rural Residential Assistance Program (RRAP) for renovations and the Canadian Home Insulation Program (CHIP) for home insulation. Many Bands use welfare dollars under the Welfare Operational Programme to add to the house labour costs. Canada Works and other manpower programs are used for the same purpose. Thus, these funds can be used to augment the amount of money available for Band housing. The DIAND and CMHC Programs are outlined in detail below.

2.1.1 The DIAND Band Capital Housing Program

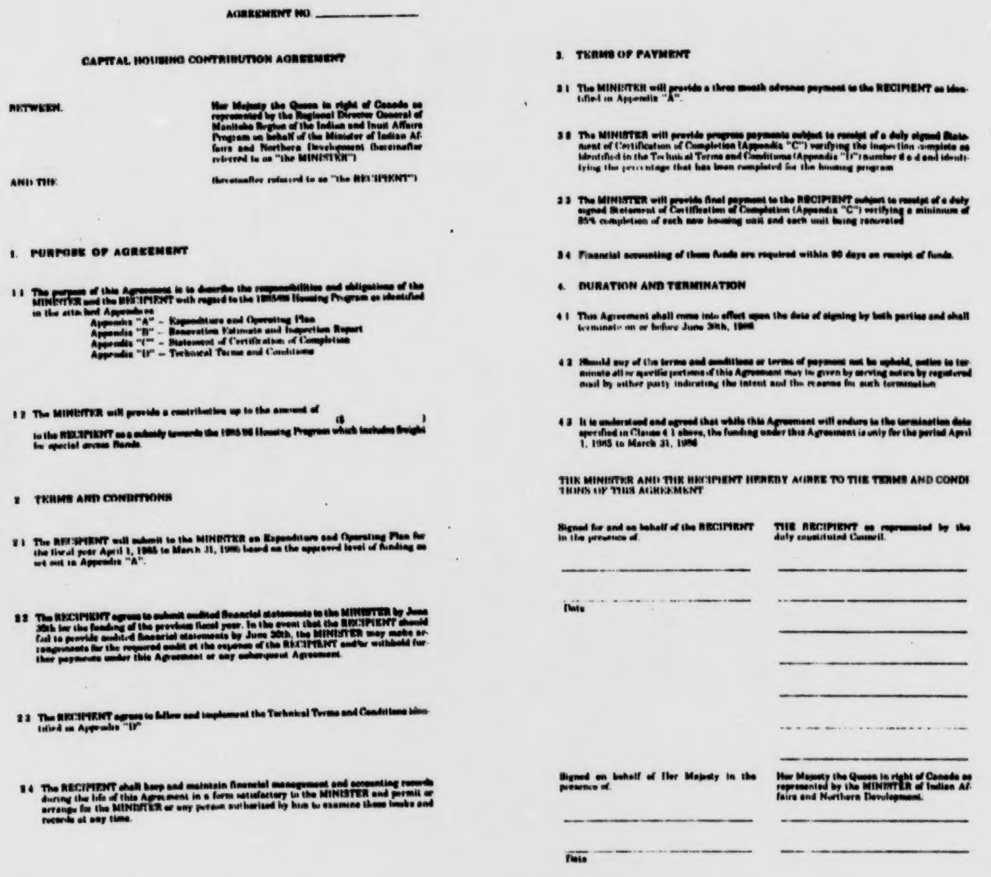
2.1.1.1 Program Operation

While Bands argue that housing is a Treaty right, the Federal Government would describe it as a programatic commitment made by the Federal government to supply housing to Status Indians living on reserve. DIAND Headquarters in Ottawa allocates the Regions a global budget together with targets for numbers of houses to be built or renovated. The housing dollars available vary depending upon the location of the reserve. For example, a III-A urban Winnipeg classified reserve such as Dakota Tipi receives $28,715, the minimum allowed for units, whereas Tadoule is classed as a IV-B Special Access Thompson reserve and it receives $44,395. These are the figures for Fiscal Year 1984-85. For all practical purposes, the difference between the upper and lower categories is the cost to ship and construct a house in the various communities. Bands will use other funds such as Canada Works to supplement their housing expenditures.

Money for housing is transferred to the Bands through a Contribution Agreement authorized for that purpose shown in Figure 2.1. The Band is required to file an estimate of the costs of the housing and a plan for their distribution (Appendix A of the Agreement). The houses must be inspected (Appendix B) by inspectors designated by the DIAND. Generally, houses built in the last few years meet the National Building Code (Part 9) as a minimum. Houses are inspected 3-4 times during the critical phases of construction. The Bands get 80% of the money up front. A further 10% is advanced when the houses in any project are 60% complete. The final 10% is advanced upon 85% of completion of the house (e.g. trim, soffits, etc. not completed). Appendix C shows the certificate of completion. Finally, Appendix D outlines the technical terms and conditions of the Contribution Agreement. The Agreement with the Appendices is shown in Figure 2.1.

2.1.1.2 Relationship to Reserve Housing Needs

In 1984-85, DIAND Manitoba Region committed to build 434 new houses and to renovate 341 houses on Manitoba reserves (see Table 2.1). The Bands contest that these construction and renovation figures do not satisfy the pressing housing needs that exist on Manitoba's reserves. Estimation of housing need in a way that meets the approval of the Bands and DIAND's is no simple task. The needs estimates used by DIAND are based upon historical trends derived from a 1977 housing needs survey conducted by the department. A more recent study of housing needs has been commissioned but there is nothing available from this study. In addition, DIAND has compiled an estimate of housing backlog to distribute additional housing funds made available in 1983-84. The options used to distribute the funds is shown in Figures 2.2 and 2.3. The data indicate



AGREEMENT NO. ____________

CAPITAL HOUSING CONTRIBUTION AGREEMENT

BETWEEN: Her Majesty the Queen in right of Canada as represented by the Regional Director General of Manitoba Region of the Indian and Inuit Affairs Program on behalf of the Minister of Indian Affairs and Northern Development (hereinafter referred to as "the MINISTER")

AND THE (hereinafter referred to as "the RECIPIENT")

1. PURPOSE OF AGREEMENT

1.1 The purpose of this Agreement is to describe the responsibilities and obligations of the MINISTER and the RECIPIENT with regard to the 1985/86 Housing Program as identified in the attached Appendices
- Appendix "A" – Expenditure and Operating Plan
- Appendix "B" – Renovation Estimate and Inspection Report
- Appendix "C" – Statement of Certification of Completion
- Appendix "D" – Technical Terms and Conditions

1.2 The MINISTER will provide a contribution up to the amount of ($) to the RECIPIENT as a subsidy towards the 1985/86 Housing Program which includes freight for special access Bands.

2. TERMS AND CONDITIONS

2.1 The RECIPIENT will submit to the MINISTER an Expenditure and Operating Plan for the fiscal year April 1, 1985 to March 31, 1986 based on the approved level of funding as set out in Appendix "A".

2.2 The RECIPIENT agrees to submit audited financial statements to the MINISTER by June 30th for the funding of the previous fiscal year. In the event that the RECIPIENT should fail to provide audited financial statements by June 30th, the MINISTER may make arrangements for the required audit at the expense of the RECIPIENT and/or withhold further payments under this Agreement or any subsequent Agreement.

2.3 The RECIPIENT agrees to follow and implement the Technical Terms and Conditions identified as Appendix "D"

2.4 The RECIPIENT shall keep and maintain financial management and accounting records during the life of this Agreement in a form satisfactory to the MINISTER and permit or arrange for the MINISTER or any person authorized by him to examine these books and records at any time.

3. TERMS OF PAYMENT

3.1 The MINISTER will provide a three month advance payment to the RECIPIENT as identified in Appendix "A".

3.2 The MINISTER will provide progress payments subject to receipt of a duly signed Statement of Certification of Completion (Appendix "C") verifying the inspection complete as identified in the Technical Terms and Conditions (Appendix "D") number 6 a d and identifying the percentage that has been completed for the housing program

3.3 The MINISTER will provide final payment to the RECIPIENT subject to receipt of a duly signed Statement of Certification of Completion (Appendix "C") verifying a minimum of 85% completion of each new housing unit and each unit being renovated

3.4 Financial accounting of these funds are required within 90 days on receipt of funds.

4. DURATION AND TERMINATION

4.1 This Agreement shall come into effect upon the date of signing by both parties and shall terminate on or before June 30th, 1986

4.2 Should any of the terms and conditions or terms of payment not be upheld, notice to terminate all or specific portions of this Agreement may be given by serving notice by registered mail by either party indicating the intent and the reasons for such termination

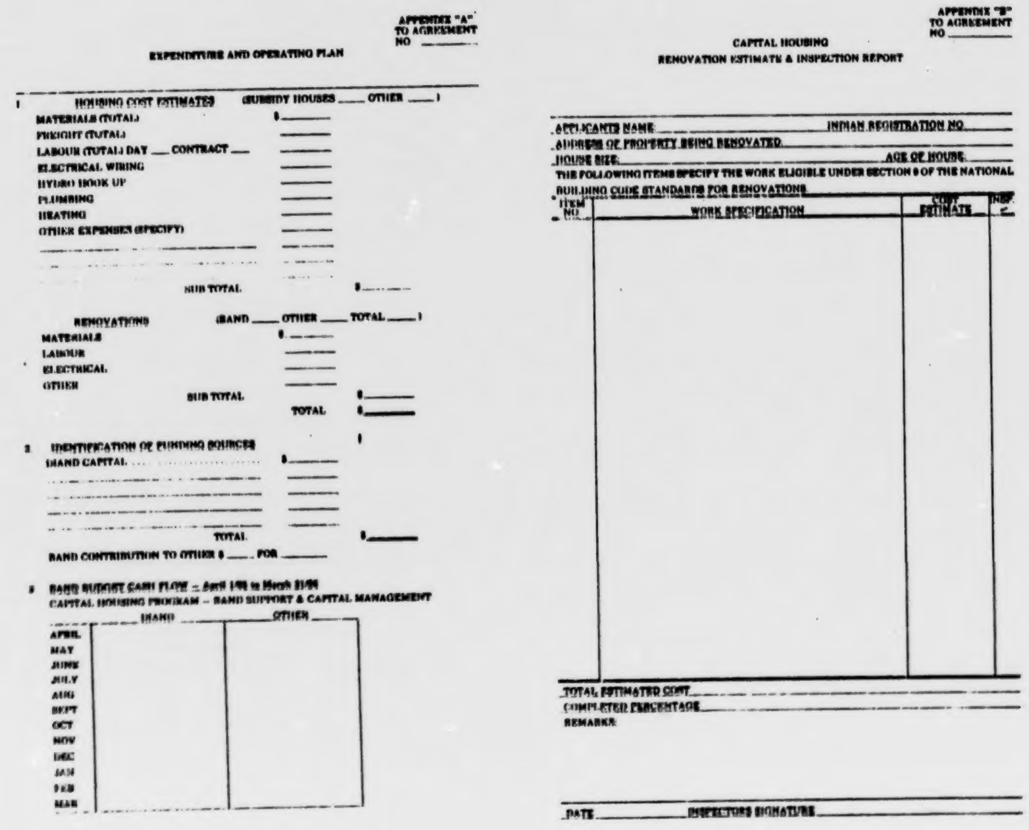
4.3 It is understood and agreed that while this Agreement will endure to the termination date specified in Clause 4.1 above, the funding under this Agreement is only for the period April 1, 1985 to March 31, 1986

THE MINISTER AND THE RECIPIENT HEREBY AGREE TO THE TERMS AND CONDITIONS OF THIS AGREEMENT

Signed for and on behalf of the RECIPIENT in the presence of.	THE RECIPIENT as represented by the duly constituted Council.
____________	____________
____________ Date	____________
	____________
	____________
	____________
	____________
	____________
Signed on behalf of Her Majesty in the presence of.	Her Majesty the Queen in right of Canada as represented by the MINISTER of Indian Affairs and Northern Development.
____________	____________
____________ Date	____________

Figure 2.1

DIAND Capital Housing Contribution Agreement



APPENDIX "A"
TO AGREEMENT
NO ________

EXPENDITURE AND OPERATING PLAN

1 HOUSING COST ESTIMATES (SUBSIDY HOUSES ____ OTHER ____)

MATERIALS (TOTAL) $________
FREIGHT (TOTAL) ________
LABOUR (TOTAL) DAY ___ CONTRACT ___ ________
ELECTRICAL WIRING ________
HYDRO HOOK UP ________
PLUMBING ________
HEATING ________
OTHER EXPENSES (SPECIFY) ________
____________ ________
____________ ________
____
SUB TOTAL $________

RENOVATIONS (BAND ____ OTHER ____ TOTAL ____)

MATERIALS $________
LABOUR ________
ELECTRICAL ________
OTHER ________
SUB TOTAL $________
TOTAL $________

2 IDENTIFICATION OF FUNDING SOURCES

BAND CAPITAL .... $________
____________ ________
____________ ________
____________ ________
____________ ________
TOTAL $________

BAND CONTRIBUTION TO OTHER $ ____ FOR ________

3 BAND BUDGET CASH FLOW – April 1/85 to March 31/86
CAPITAL HOUSING PROGRAM – BAND SUPPORT & CAPITAL MANAGEMENT

	BAND	OTHER
APRIL		
MAY		
JUNE		
JULY		
AUG		
SEPT		
OCT		
NOV		
DEC		
JAN		
FEB		
MAR		

APPENDIX "B"
TO AGREEMENT
NO ________

CAPITAL HOUSING
RENOVATION ESTIMATE & INSPECTION REPORT

APPLICANTS NAME ____________ INDIAN REGISTRATION NO. ________
ADDRESS OF PROPERTY BEING RENOVATED ____________
HOUSE SIZE ____________ AGE OF HOUSE ________
THE FOLLOWING ITEMS SPECIFY THE WORK ELIGIBLE UNDER SECTION 9 OF THE NATIONAL BUILDING CODE STANDARDS FOR RENOVATIONS

ITEM NO	WORK SPECIFICATION	COST ESTIMATE	INSP. ✓

TOTAL ESTIMATED COST ____________
COMPLETED PERCENTAGE ____________
REMARKS:

DATE ________ INSPECTORS SIGNATURE ____________

Figure 2.1

DIAND Capital Housing Contribution Agreement

Figure 2.1

DIAND Capital Housing Contribution Agreement

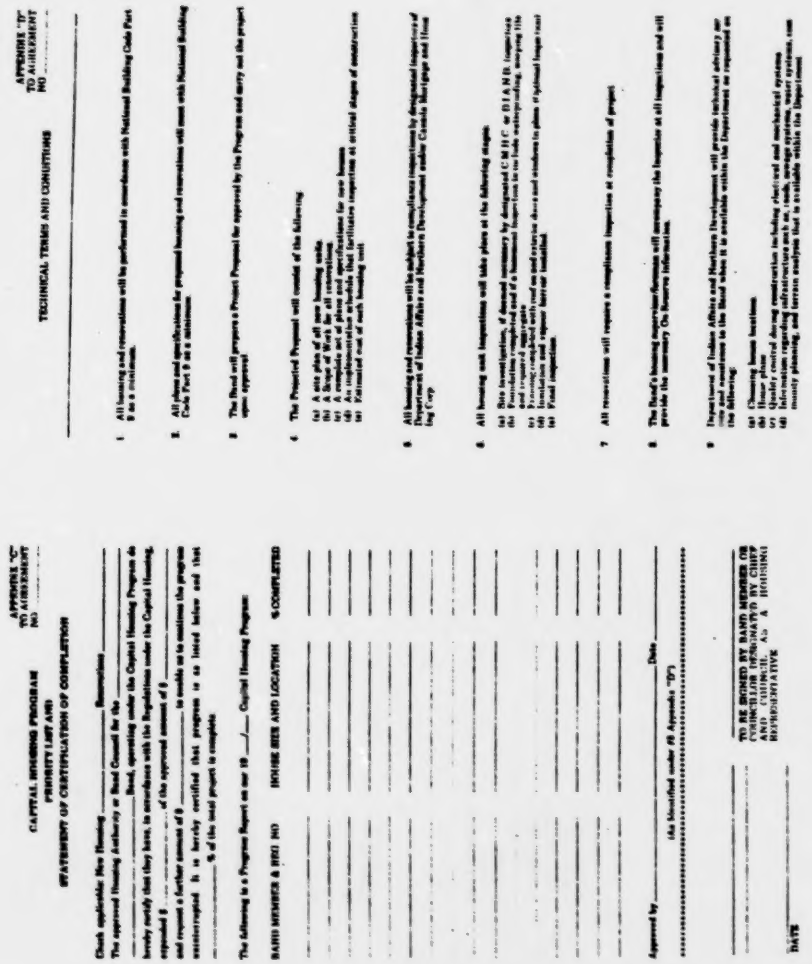


Table 2.1

DIAND Capital Housing Allocations as at March 84

NAME OF BAND	POP.	ECONOMIC FACTOR	GEO. ZONE	CENTRE[1]	MAX./$ UNIT	PROGRAM[2] NEW REN.
BARREN LANDS	307	IVB	Sp. Access	T	44,395	4 - 1
BERENS RIVER	773	IVB	Sp. Access	W	38,526	9 - 8
BIRDTAIL SIOUX	204	IIIB	Rural	W	29,625	5 - 0
BLOODVEIN	420	IVB	Sp. Access	W	38,526	5 - 6
BROKENHEAD	186	II	Urban	W	28,715 19,505	3 - 4
BUFFALO POINT	21	IIIA	Rural	W	28,715 26,625	1 - 0
CHEMAWAWIN	376	IVA	Remote	TP	(28,715) 40,308	+1 4 - 2
CHURCHILL	242	IVB	Sp. Access	T	44,395	5 - 8
CRANE RIVER	121	IIIB	Rural	W	29,625	3 - 5
CROSS LAKE	1,955	IVA	Remote	TP	40,308	18 - 10
DAKOTA PLAINS	106	IIIA	Urban	W	28,715 23,505	1 - 5
DAKOTA TIPI	51	IIIA	Urban	W	28,715 23,505	1 - 5
DAUPHIN RIVER	97	IVA	Rural	W	32,625	2 - 2
EBB AND FLOW	428	IIIA	Rural	W	28,715 26,625	6 - 8
FAIRFORD	735	IIIB	Rural	W	29,625	6 - 12
FISHER RIVER	838	IIIA	Rural	W	28,715 26,625	14 - 5
FORT ALEXANDER	1,897	IIIA	Rural	W	28,715 26,625	23 - 7
FOX LAKE	272	IVB	Sp. Access	T	44,395	2 - 6
GAMBLERS	20	IIIB	Rural	W	29,625	1 - 2
GARDEN HILL	1,679	IVB	Sp. Access	W	38,526	19 - 7
GOD'S LAKE	960	IVB	Sp. Access	TP	42,308	10 - 5
GOD'S RIVER	253	IVB	Sp. Access	TP	42,308	3 - 4

---

[1] W - WINNIPEG, T - THOMPSON, TP - THE PAS

[2] NEW means new housing, REN means renovation.

Table 2.1

(Continued)

NAME OF BAND	POP.	ECONOMIC FACTOR	GEO. ZONE	CENTRE[1]	MAX./$ UNIT	PROGRAM[2] NEW REN.
GRAND RAPIDS	275	IVA	Rural	W	32,625	5 - 5
HOLLOW WATER	422	IIIA	Rural	W	28,715 26,625	6 - 6
INDIAN BIRCH	146	IVA	Rural	TP	35,851	2 - 5
JACKHEAD	200	IIIB	Rural	W	29,625	3 - 10
KEESEEKOWENIN	216	IIIA	Rural	W	28,715 26,625	3 - 5
LAKE MANITOBA	479	IIIA	Rural	W	28,715 26,625	5 - 14
LAKE ST. MARTIN	489	IIIB	Rural	W	29,625	8 - 5
LITTLE BLACK RIVER	237	IIIA	Rural	W	28,715 26,625	3 - 3
LITTLE GRAND RAPIDS	860	IVB	Sp. Access	W	38,526	11 - 8
LITTLE SASKATCHEWAN	211	IIIB	Rural	W	29,625	3 - 6
LONG PLAIN	525	IIIA	Urban	W	28,715 23,505	10 - 6
MATHIAS COLOMB	1,216	IVB	Sp. Access	T	44,395	6 - 0
MOOSE LAKE	323	IIIB	Remote	TP	37,308	+2 2 - 8
NELSON HOUSE	1,956	IVA	Rural	T	37,631	10 - 6
NORTHLANDS	418	IVB	Sp. Access	T	44,395	6 - 0
NORWAY HOUSE	2,279	IVA	Remote	TP	40,308	+3 20 - 9
OAK LAKE SIOUX	258	IIIB	Rural	W	29,625	3 - 1
OXFORD HOUSE	1,104	IVB	Sp. Access	TP	42,308	17 - 0
PEGUIS	1,500	IIIA	Rural	W	28,715 26,625	+3 20 - 14
PINE CREEK	435	IVA	Rural	W	32,625	4 - 13
POPLAR RIVER	545	IVB	Sp. Access	W	38,526	9 - 2
RED SUCKER LAKE	341	IVB	Sp. Access	W	38,526	4 - 5

---

[1] W - WINNIPEG, T - THOMPSON, TP - THE PAS
[2] NEW means new housing, REN means renovations.

Table 2.1

(Continued)

NAME OF BAND	POP.	ECONOMIC FACTOR	GEO. ZONE	CENTRE[1]	MAX./$ UNIT	PROGRAM[2] NEW REN.
ROLLING RIVER	244	IIIA	Rural	W	28,715 26,625	3 - 9
ROSEAU RIVER	571	II	Urban	W	28,715 19,505	11 - 3
SANDY BAY	1,497	IIIA	Rural	W	28,715 26,625	19 - 8
SHAMATTAWA	567	IVB	Sp. Access	T	44,395	6 - 4
SHOAL RIVER	517	IVA	Rural	TP	35,851	4 - 4
SIOUX VALLEY	729	IIIA	Urban	W	28,715 23,505	12 - 7
SPLIT LAKE	1,069	IVA	Rural	T	37,631	10 - 4
ST. THERESA POINT	1,342	IVB	Sp. Access	W	38,526	15 - 10
SWAN LAKE	216	IIIA	Rural	W	28,715 26,625	4 - 4
THE PAS	1,264	IIIB	Urban	TP	29,285	10 - 13
VALLEY RIVER	252	IIIB	Urban	W	28,715 26,505	3 - 8
WASAGAMACK	668	IVB	Sp. Access	W	38,526	8 - 10
WATERHEN	296	IIIB	Rural	W	29,625	5 - 7
WAYWAYSEECAPPO	548	IIIB	Rural	W	29,625	7 - 2
YORK FACTORY	301	IVB	Sp. Access	T	44,395	3 - 1
WAR LAKE	24	IVB	Sp. Access	T	44,395	N/A
					TOTAL	434 - 341

---

[1] W - WINNIPEG, T - THOMPSON, TP - THE PAS
[2] NEW means new housing, REN means renovation.

Source: DIAND Manitoba Region

Figure 2.2
DIAND's Housing Needs Analysis (1983-84)

*NET BACKLOG

BAND		GROSS BACKLOG	CMHC UNITS	NET BACKLOG
1.	NELSON HOUSE	304	-	304
2.	MATHIAS COLOMB	168	-	168
3.	FORT ALEXANDER	165	-	165
4.	CROSS LAKE	132	7	125
5.	NORWAY HOUSE	131	7	124
6.	THE PAS	97	-	97
7.	GOD'S LAKE	71	-	71
8.	SPLIT LAKE	67	-	67
9.	ST. THERESA POINT	66	-	66
10.	SANDY BAY	61	-	61
11.	BERENS RIVER	60	-	60
12.	SHAMATTAWA	54	-	54
13.	LITTLE GRAND RAPIDS	50	-	50
14.	PEGUIS	49	17	32
15.	FAIRFORD	38	11	27
16.	OXFORD HOUSE	38	-	38
17.	WASAGAMACK	33	-	33
18.	WATERHEN	22	-	22
19.	SHOAL RIVER	20	-	20
20.	YORK FACTORY	19	-	19

* BASED ON 4.0 MEMBER FAMILY UNIT WITH CMHC 56.1 UNITS DEDUCTED FROM THE GROSS BACKLOG.

that the backlog is generally much greater on the northern reserves than on the southern reserves.

The four communities in the study, namely Pukatawagan, Lac Brochet, Brochet and Tadoule Lake have had housing needs surveys done in 1983. The questionnaires provided detailed information on specific houses but since no summary data from the questionnaires had been prepared, little data could be used for this study.

2.1.2 CMHC's 56.1 Non Profit Housing Program

2.1.2.1 Program Operational Overview

This program receives its authority from Section 56.1 of the National Housing Act (NHA). About 350 CMHC units have been built on Manitoba's reserves since 1978. The program provides a subsidy on a mortgage so as to write down the effective interest rate to 2% for a 35 year loan. The program is different than the usual DIAND subsidy programs.

> "The Band must realize that they have to administer a housing portfolio for the duration of the load (accept the responsiblity of a Landlord/Tenant relationship), maintain the units in a reasonable state of repair and accept the consequences to the Band should a situation of default occur. The Band should note that a Breach of the Operatory Agreement with CMHC will bring about termination of further subsidy assistance. (p. 4)"[1]

This money comes from Canadian financial institutions. As building housing on reserve offers no legal protection to the lender in the case of a default, the DIAND Minister must guarantee the loan.

There is a positive side to the program, however. If the Band is willing to accept this new way of building housing and to comply with the regulations outlined in the Handbook, they can use their housing capital dollars as equity for constructing CMHC housing. For $40,000 one can build one DIAND subsidy house or 2 or 3 CMHC houses which are built to a much higher standard (See figure 2.4 for the Maximum Unit Prices (MUP) allowed).

---

[1] CMHC Band Owned Rental Housing Program Handbook, p. 4.

Figure 2.3

Option 5 Housing Capital Allocation

OPTION 5

This option would appear to provide the most equitable allocation.

Urban: Not applied. The six Bands in this category are included in the Rural classification.

Rural: Base of $23,265 per unit plus economic subsidy of $5,450 for a total increase of $7,975 less the freight included in original budget. i.e. assuming a Band had been identified for one (1) unit, (prior to the increase) in the amount of $20,750 plus $250 for freight; increase in this case would be $7,965 less $250 for a net increase of $7,715.

Estimated cost $7,965 x 265 units = $2,110,725.

Remote and Special Access: Base of $30,187 plus economic subsidy of $4,528 per unit for a net increase of $12,580 per unit. For Remote, the freight allowance would be deducted and actual cost of freight allowed for Special Access.

Estimated cost $12,580 x 138 units = $1,736,040.

Plus Special Access Freight	=	$ 350,000.
Total	=	$2,086,040.
Approximate Grand Total	=	$4,196,765.

This MUP or lending value is determined using the Marshall Cost Handbook designed for use by appraisers in the USA. Critics of this approach argue that the Cost Handbook cannot be applied to the North. Further, appraising new designs on consideration of variances to CMHC's Residential Housing Standards (1980) or a re-interpretation of CMHC's Modest Housing Guidelines (1984) which require appraisal judgement usually result in the innovations not being accepted. This is not to fault the CMHC appraisal staff. They are responsible for implementing CMHC's guidelines. Staff do not want to take precedent setting actions such as setting new criteria for appraised lending values given the limited experience in this field. But in the words of one housing official, CMHC's Residential Housing Standards "don't cut the mustard in Norway House".

2.1.2.2 An Example of the Program's Operation

The CMHC Handbook outlines the operation of the program in great detail. Readers are referred to this document for further clarification. This section explains the operation of the program by means of an example.

Suppose the CMHC house cost is $69,000. The Land value is set at $3,500 and the Band must supply $9,000 equity (usually from its DIAND Capital Housing budget). Therefore, the loan required is $56,500.

Next one must determine income. This is shown in Table 2.2. Suppose that John and Mary Doe and their three children wish to own a CMHC home. They will pay 25% of their adjusted family income for a fully serviced unit. This Adjusted family income is $1391.66 monthly. Their maximum rent including principle, interest, taxes (if applicable) and heating is $341.91 monthly.

Table 2.2

Rent-To-Income Calculation

John Doe Income .... $12,600.00 ann.
Mary Doe Income .... 5,000.00 ann.

Total Gross Income .... $17,600.00 ann.

Less Allowance for Spouse: .... $ 900.00

Total adjusted annual Family Income... $16,700.00

Divide by 12 for monthly income = 16,700 ÷ 12 = 1,391.66/month

25% of 1,391.66 = $347.91

Less allowance of $2.00 per child = 3 x 2 $ 6.00

Maximum Monthly Payment $341.91

NOTE: If the Band has chosen to have the tenant pay his/her own utilities the "rent-to-income" will be adjusted as follows:

Fully Serviced rent $341.91
Monthly utilities .... -100.00
Unserviced rent $241.91

Annual Operating costs must be determined. This is outlined in Table 2.3 below:

Table 2.3

Annual Operating Costs (Budget)

Insurance	220.00
Maintenance	240.00
Utilities	1,200.00
Administration	400.00
Replacement Reserve	400.00
Contingency	150.00
	$2,610.00*

*Note: Water Delivery, Pump-out and Garbage removal may also be applicable.

Annual loan payment to Lender at 13.25%
Loan Amount: $56,500 x (.010870592) = 7,370.16

Total Annual Operating Costs = $2,610.00
$7,370.16
$9,980.16 annually

Note: $9,980.16 (or $9,980.16 ÷ 12 = $831.00) is the "economic rent" (what the rent would be if there was no CMHC assistance)

Finally the Section 56.1 Assistance is calculated (See Table 2.4).

Table 2.4

Section 56.1 Assistance by CMHC

Interest Rate 13.25% (5 year term) 35 year amortization
13.25% (.010870592) x $69,000 = $750.07 mo. = $9,000.84 ann.

Interest Rate 2%
2% (.003308380) x $69,000 = $228.28 mo. = $2,739.36 ann.

Maximum CMHC Subsidy $521.79 mo. $6,261.48 ann.

NOTE: The CMHC assistance is always calculated on the "total approved project cost". See Section 2.1.2.2.

The total annual operating costs from Table 2.3 are $9,980.16 whereas the maximum annual CMHC assistance from Table 2.4 is $6,261.48. Thus, the minimum rent that the Band must collect is $3,718.68 or $309.89/Mo. This represents the "Mini-Max" Rent for this Unit. The "Mini-Max" rent is the minimum rent the Band has to collect from the tenant, which together with the CMHC Assistance, is sufficient to operate the unit and make the required payment to the Lender. The Band may choose to have the tenant pay his/her own utilities. In this case "Utilities" as shown in the Budget will be reduced from the rents required i.e.: $3,718.68 - $1,200.00 = $2,208.79 Ann. or $187.04 monthly.

In sum, CMHC will provide assistance based on the loan interest rate and the approved total cost of the project as well as the approved operating costs. The Section 56.1 assistance "writes down" the interest rate to as low as 2%. The loan repayment is calculated on the approved total cost of the project at the current interest rate for a specific loan term and amortization period. Then, the loan repayment is calculated at a 2% interest rate applicable to the aforementioned. The difference between the first and second calculations is the maximum amount of CMHC Section 56.1 Assistance that the Band will receive. The amount of annual CMHC Section 56.1 Assistance the Band will receive, as determined by the previous calculations, is subtracted from the total approved annual operating costs. The resultant amount is the minimum the Band must collect from the tenant is the actual rent required.

In order to ensure the actual rents (mini/max) required by the Band balance with the rents-to-income, "Blending of Incomes" will be required to make a project viable. For example, the rent-to-income for one particular tenant may be higher than the actual rent the Band must collect, and it may be lower in the case of another tenant. The important thing is that the total amount of rent-to-income that the tenants can pay, equals or preferably exceeds the total rent (mini/max) the Band needs to collect.

2.1.2.3 Impact of Design Changes and their Costs on the CMHC Program Assistance

It should be evident to readers that CMHC's assistance per house is enormous over the period of the loan. Assuming that mortgage money remains at 13 1/4%, the assistance over 35 years is $6,261.48/year x 35 years = $219,151.8 or 3.2 times the value of the house.

If one were to add $5,000 to the house in capital, this addition of capital dollars could result in a reduction of energy costs or maintenance costs.

If the rent level was kept the same and the savings that resulted permitted a reduction in the term of the loan by one or more years, such an action would save CMHC one or more annual subsidies of $6,261.48.[1] Hence, strategic investments in house designs could reduce CMHC's liability for subsidy dollars dramatically.

The second issue that one must consider is that the term of the loan is 35 years. Indian housing traditionally has only lasted 10-15 years, largely because the housing was of poor quality and because of the severe conditions that the houses are put through. If the CMHC house lasts less than 35 years or the term of the mortgage loan, then one is paying for an asset which has no value. This reality only serves to strengthen the need to design homes which can last longer, even though there may be an increase in the initial capital cost.

2.1.3 Impact of the CMHC 56.1 Modest Housing Guidelines on this Housing Design Exercise

The Handbook notes that "CMHC will only approve a project for the construction of 'Modest Housing'. There is a restriction on the 'total size and cost of the unit', based one bedroom count, to better ensure that the units and all related costs fall into the definition of modest and are affordable by the Band (p. 6 Handbook)".

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[1] The analysis in reality is much more complex in that one must consider the time value of money in the analysis. CMHC does not have to supply the subsidy until the year it is required. It can take its subsidy required in year 35 and invest it for the period until it is needed. Conversely, the "present value" of the subsidy of $6,261.48 to be paid in year 35 at 13 1/4% is only worth $80.42. On the other hand, the houses may not last the full 35 years. Thus one is paying money for a worthless asset. Reducing the term of the mortgage loan is therefore key.

The handbook writers continue:

> "These houses will be built to CMHC Standards. CMHC Standards will provide accommodation that is adequate for the tenants' needs, and will last much longer than houses previously built .... It is to be noted that CMHC must be able, through its appraisal department, to substantiate the total costs of the project. This is called the lending value. The total cost of the project must not exceed this value. (p. 6 Handbook)"

2.1.3.1 Analysis of the Guidelines

The Design Team has reviewed CMHC's Modest Housing Guidelines because the Guidelines will likely impose a constraint on the design exercise. The following is a brief analysis of the modest Housing Guidelines and the constraints that they may impose on innovative design.

"1. General

"1.1 The design and provision of modest housing should be governed in all aspects by the "best buy" principle.

This guideline could have the effect of discouraging local use of labour and materials because, at least initially, the local supply might not be the best buy in private terms but may be the "best buy" for the community. One would hope that a relation of this guideline would encourage local suppliers of housing goods and services and in time, they would represent the "best buy". The Labour/Materials split in housing is about 40%/60%. About 25% of the labour cost is local labour.

"1.2 The level of quality offered locally by the private sector should not be exceeded, providing minimum CMHC Standards are met.

There is no private sector housing market on the reserve. CMHC housing built on the reserve will, for at least the next 10 years, exceed the quality of the existing reserve housing stock by virtue of the fact that the housing is built to CMHC's standard.

"1.3 Innovation in construction materials, system or techniques is acceptable only if cost savings can be demonstrated.

This guideline is interpreted to mean savings in capital costs, not savings in capital and operating costs combined. Hence, design innovations which are more expensive in capital costs but which may save on maintenance or energy expenses over the life of the house are hard to justify.

"1.4 For wood frame structures, the requirements of "Residential Standards" should not be exceeded without clear justification.

CMHC's social housing officers can't interpret standards. This is done by the appraisers. To change the interpretation of the standards, one must do a presentation to CMHC regional management. Such a process may be justified but it will place a real burden on the designer to justify thoroughly the innovation that is proposed.

"1.5 Durability and ease of maintenance should determine the selection of materials.

This excellent guideline unfortunately conflicts with guidelines 1.3 and 1.4.

"1.6 Rehabilitation of existing buildings should only be undertaken if costs are not increased and if the quality of housing provided is not compromised in terms of unit planning, room sizes, outdoor living spaces, privacy and parking. Restoration of historic or architectural detail, is not regarded as modest.

This guideline will have little relevance to reserve situations.

"2. Site Selection and Development

"2.1 Sites should be selected which do not present excessive development costs due to such factors as size, irregular shape, steep slopes, low bearing capacity, soil problems, noise exposure, or lack of services.

Sites in northern Manitoba generally are poor and result in high development costs. Houses with no Hydro line have only a 15 amp service instead of the 100 amp service available. Proposals for new house construction can be rejected on this basis.

"2.2 **Areas with high land costs or restrictive zoning should be avoided.**

Not applicable to reserves.

"2.3 **The number of parking spaces provided should not exceed the recommendations found in Table 1 of NHA 5239 "Parking Areas Advisory Document".**

Requirements for parking, sidewalks and concrete drives have little relevance in remote communities.

"2.4 **The following elements are considered immodest:**
- **a) Multi-level parking structures.**
- **b) Garages and car ports.**
- **c) Landscaping, fencing and site development in excess of local norms.**

Sodding around a house will reduce mud being tracked into the house. The Design Team is aware of at least one Band which installed sod on its CMHC houses using other sources of funds.

"3. **Housing Form and Building Design**

"3.1 **Densities should be selected which permit reasonable land costs per unit; at the same time, high rise construction over six storeys should be avoided due to the increased costs associated with structure, elevators and fire protection.**

Not relevant to reserves.

"3.2 **Housing forms should be simple and compact to minimize exterior wall and roof surfaces and permit ease of construction; staggering of row units should be done in pairs or greater.**

A bi-level results in the best Maximum Unit Price. Such a restriction can limit design flexibility. Bungalows have been the most common housing in the north.

"3.3 **Split level forms should be avoided; bungalow forms are acceptable only for units designed for the disabled or for seniors.**

The impact of this guideline is self-explanatory. Such a guideline results in bi-levels being predominant.

"3.4 **New buildings should contain at least four dwelling units, except in rural and other special areas.**

The interpretation of this guideline is unknown.

"3.5 **The number of different housing forms and unit layouts should be minimized, and should be appropriate to the number of units in the project.**

This can limit design flexibility and detract in the creation of desirable architectural spaces.

"3.6 **Housing forms which create less than optimal spaces, such as full basements used only for storage, multi-storied spaces, or spaces with heights less than 1.95 m, should be avoided.**

This guideline can limit flexibility (eg. dormer spaces).

"3.7 **The following elements are considered immodest:**
- **a) Excessive overhangs and large canopies.**
- **b) Terrace roofs.**
- **c) Unused spaces.**
- **d) Inefficient access and circulation.**

Item (c) will restrict the construction of a "mud-room" - a heated space that will permit the storage of materials and will function as a room to repair snowmobiles and skin animals. Spaces of this type are accepted if they are called "bulk storage" or something more acceptable.

"3.8 **In buildings for the elderly:**
- **a) Communal amenity spaces should not exceed 3.5 m^2 per person.**
- **b) Only one administrative office should be provided.**
- **c) Communal balconies or terraces are preferred to individual balconies.**

Buildings for the elderly which would be built on reserve would be small relative to other urban elderly persons' housing built in the south. One may need a certain minimum size of amenity space for certain activities which could not be accommodated under item (a).

"3.9 **In buildings for families:**
- **a) A separate community building should not be considered for projects of less than 75 units.**
- **b) No office or meeting room should be provided for projects with 10 units or less.**
- **c) Communal indoor amenity spaces should not exceed 2.5 m^2 per unit.**
- **d) Elevators and garbage chutes should not be installed in buildings with 3 storeys or less.**

Items (a), (b) and (c) could pose restrictions for the reserve situation given that project sizes are smaller in the north than in the urban areas such as Winnipeg.

***4. Dwelling Units**

***4.1 Maximum Areas: Apartment Forms**
Net floor areas (measured from the inner surface of all walls enclosing the unit, excluding bulk storage and mechanical/utility rooms) should not exceed the following:

	Senior	Family
Bachelor	38 m²	37 m²
1-Bedroom	52	56
2-Bedrooms	70	74
3-Bedrooms	-	93
4-Bedrooms	-	111

The guidelines could restrict design flexibility.

***4.2 Maximum Areas: Non-Apartment Forms**
Gross floor areas (measured from the outside surface of exterior walls and the centre line of party walls, excluding bulk storage and mechanical/utility rooms, including stairways on each level) should not exceed the following:

	Senior	Family
Bachelor	40 m²	-
1-Bedroom	54	60
2-Bedrooms	78	84
3-Bedrooms	-	102
4-Bedrooms	-	121

Maximum areas are pushed up by having an interior storm porch on by in-house storage to work on snowmobiles, etc.

***4.3 Floor areas for units designed for the disabled may exceed the above maximums by 4%.**

This guideline may or may not restrict design guidelines.

***4.4 Floor areas for units built in the Northwest Territories may exceed the above maximums by 5%.**

There is really no difference between Northern Manitoba and the NWT, however, the increased floor space does not apply to Manitoba.

***4.5 The following elements are considered immodest:**
- **a) Dishwashers, microwave ovens, other special appliances.**
- **b) Fireplaces or wood burning stoves, unless used as the primary source of heating.**
- **c) Glazed balconies, greenhouses, skylights, special windows.**
- **d) More than one eating area.**
- **e) Non-standard wall, ceiling and floor finishes.**
- **f) Additional baths or half baths for 2-bedroom units: larger units may be allowed an additional bath or half bath if it is not on the same floor level as the main bath.**
- **g) Sunken or raised floor levels.**
- **h) Elevated decks or balconies in grade-related units.**

Interpretation of these guidelines for immodesty could restrict design flexibility. For example, in any project (a semi-institutional home project) plywood behind drywall was necessary for maintaining the wall surface from damage. Such a finish was considered immodest by guideline (e). Greenhouses and special windows may be desirable features that serve an important function but such spaces are also considered immodest. Use of radiant heat is not accepted by CMHC as a primary heating source.

2.1.3.2 Concluding Remarks on the Guidelines

The guidelines, while written with the best of intent to ensure that housing is made affordable, can restrict innovative solutions to housing in Northern Manitoba. The Design Team must, however, work within the guidelines and must provide the necessary justifications when the guidelines need to be altered.

2.2 The Economic/Industrial Benefits of Providing Housing in Northern Manitoba

This section of the report reviews historical information available on the various plans and studies available on the industrial and economic benefits associated with the provision of housing in northern Manitoba. The major planning and design exercises were as follows:

- Northern housing designs prepared by The Northern Housing Committee (1972).
- The Remote Housing Program (1973-1974).
- The Northern Manitoba Development Strategy (1976).
- The Keewatin Tribal Council (KTC) Planning Strategy & Economic Conference (1982).
- The Northern Development Agreement Strategy (1984).

2.2.1 The Northern Housing Committee (1972)

The University of Manitoba Northern Housing Committee (NHC) presented a proposal for a multi-year R&D program on housing in northern Manitoba. The Committee in its March 1972 proposal noted that

> "there still remain outstanding a number of problems in the field of housing (11, 12). At the remote end of the housing spectrum, the problems of foundation movement, internal water vapour management, heating, water supply, insulation and cost of construction still require a great deal of development. **At the other end of the spectrum, simple and reliable self-contained domestic service units have yet to be designed and demonstrated for single family dwellings.** In both cases, the management and reduction of wastage of heat energy requires a great deal of further attention." (p. 4)[1]

Economic issues were of great concern to the NHC:

> "In addition, because of the relatively low level of economic activity in many remote communities, it is clearly to their advantage to attempt to create designs and plans of housing which minimize total cost for a given level of performance, but which maximize the components of overall cost centred within the community itself. For example, **the content of local labour and local materials might be made as high as reasonably possible,** while the costs of transportation and other factors which do not directly benefit the community are minimized. Finally, **there are aspects of cultural, sociological and historical nature which cannot be ignored or overlooked in any contemporary scheme for assisting the residents of our remote northern communities.**"

> "An examination of the problems of northern housing reveals that except for some lesser details, they are not readily amenable to simple, hypothetical solution. By their very nature, the problems are complex and demand an inter-disciplinary approach to their associated research. **In addition to the basic research and the design suggestions derived therefrom, they particularly require a closely associated "development" phase, in which prototype housing units are constructed and evaluated in service.** This integration of on-going prototype evaluation with basic research and design in such a programme is essential for its success, but is one which is all too rare in housing studies."[1]

The NHC developed a prototype "Stackwall" house design (for more details see Chapters III and IV). The advantages of the system were described as follows:

- It allowed a very inexpensive house shell to be constructed if adequate quantities of sweat equity were available at zero or low cost,
- Semi-skilled labour could be used,
- Local materials could be used to a much greater extent than conventional log or frame construction (particularly small diameter timber of any species),
- Wall surfaces were very tough and durable,
- High fire resistance, and
- Reasonable thermal resistance.

However, the system was too expensive when compared to regular wood frame construction techniques. The logs in the "Stackwall" also shrunk thus creating air passages in the wall.

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[1] Northern Housing Committee Northern Housing Designs for Remote and for Self-Contained Housing Units (March 1972).

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[1] Ibid, p. 5

2.2.2 The Remote Housing Program (1973-1974)

The 1973 document entitled Northern Housing Program Performance prepared by the Office of Planning and Policy Development of the Manitoban Department of Northern Affairs recommended:

> "(1) THAT a comprehensive long term housing program for increased construction of, and renovation and repair to housing units be implemented as soon as possible. The program must include:
>
> (1) housing design innovations
>
> (2) family housing construction
>
> (3) senior citizens housing construction
>
> (4) emergency repairs
>
> (5) major renovations
>
> (6) program evaluation mechanism
>
> "Such a housing program must be run in conjunction with:
>
> (1) land development planning
>
> (2) community planning
>
> (3) home visitors program
>
> "**In addition, such a housing program could be run in conjunction with other programs to encourage the development of Northern Manitoba.** Pre-fabrication housing plants, logging operations and saw mills programs could provide a decentralized system of housing production in the North which would create job-training programs and improve incomes. This would ensure that maximum benefits of the program would accrue to Northerners.
>
> "(2) THAT a more adequate system for delivery of the program is necessary." (p. 16).

The 1974 Review of the Remote Housing Program prepared by B. Bingeman et al. reviewed the delivery of the Manitoba Government's Remote Housing Program from 1969-74 (Chapter III has more detail on the program). The Review concluded that:

> "• **On-site, stick-built construction is inefficient in terms of building time, labour, and quality of shelter. This method involves essentially no useful skills training in the majority of cases.** The overall economic benefits which accrue to communities from on-site construction are much less permanent than benefits which accrue to a northern community which operates a 'Ready-To-Move' system.
>
> "• **The Camperville 'Ready-To-Move' operation is substantially more efficient in terms of building time, labour, and quality of product.** These factors offset the transportation component. Greater benefits accrue to workers and are more permanent in that skills training is superior at the Camperville operation. More permanent benefits accrue to the community of Camperville in that the RTM system is helping to provide a viable economic base.
>
> "• **If the overall goal is to provide adequate shelter for all Manitobans regardless of income, the RTM system is a much more efficient method than on-site construction.** If the goal is to help northerners develop skills and secure maximum benefit from housing development in the North as well as to provide housing the RTM system is still more useful than on-site construction. The RTM system creates jobs of a more permanent nature, produces a higher quality of skills training to benefit northerners, and aids in the development of a community's economic base. This construction method does not seem to be inconsistent with government policy, either for housing or the North in general."
>
> "• **Given that most materials used in the Remote Housing Program are of a 'secondary' nature in that they have been pre-manufactured, a short-term solution to the origin of materials question does not seem likely if conventional frame housing is to be used.**" (pp. 46-7)

The Review recommended that:

> "ADDITIONAL READY-TO-MOVE OPERATIONS SHOULD BE ESTABLISHED IN SELECTED COMMUNITIES IN NORTHERN MANITOBA.
>
> One or more RTM operations could increase the delivery capacity of the Remote Housing Program as well as follow present government policy. The locations of the operations should be designed to serve a specific area, e.g. one could serve communities on the Churchill rail line. With a planned yearly production, the RTM system could operate all year round.
>
> A MORE USEFUL TRAINING COMPONENT SHOULD BE INTRODUCED INTO THE ON-SITE CONSTRUCTION METHOD.
>
> On-site stick-built construction will have to continue in some communities. An improved skills training component, possibly with an input from the Northern Manpower Corps, could be more beneficial to workers in the long run. It is also likely to improve the quality of house built on-site."

In the long term the Review recommended that:

> "The long term development of housing programs for Northern Manitoba should ensure that benefits of northern development accrue to Northerners. This implies a greater use of local resources, both materials and manpower. In turn, this implies a decentralized system of housing production in the remote north. Again, these are areas which should be investigated:
>
> a) **The use of community sawmills. What can they produce? Could they supply the materials needs of housing programs?**
>
> b) **The possibility of establishing community based operations to produce "secondary" materials e.g. windows, kitchen cupboards, floor coverings, ceiling tiles, etc.** These types of projects could supply materials to housing programs, create permanent worthwhile jobs, and strengthen the economic base in many communities. If these operations initially had a guaranteed northern markets, they could develop more rapidly and eventually compete in larger southern market." (pp. 47-50)

2.2.3 The Northern Manitoba Development Strategy (1976)

During 1975-76 the Province of Manitoba prepared a comprehensive social and economic strategy designed to improve the living conditions of northern Manitobans who are one of the poorest sections of Canadian society. At the time the population in the north was estimated to be 79,900 with total employment estimated to be 25,600. Population growth was 3% per annum with 48% of the population under 15 years of age. Not surprisingly, almost half the people had newer worked. These economic conditions created many social problems. The strategy was developed in an attempt to alleviate these conditions.

2.2.3.1 Northern Plan Overview

The economy of northern Manitoba is what is described as divergent - one in which what is produced locally is not consumed locally and vice versa. Raw materials are exported and finished goods which incorporate some of the raw materials are re-imported back to the north. Thus, surpluses which occur from further processing of raw materials are never generated. Surpluses generated by resource extraction industries accrue to stockholders of mining companies or to Hydro bond holders.

The exercise was considered by the Planning Secretariat of the Province of Manitoba. The plan provided a 5-year outline plan and a detailed first year plan. It was intended that the exercise would be an ongoing one with the preparation of annual detailed plans. The steps in plan were as follows:

- develop a historical understanding of the process and present state of underdevelopment in the north.
- estimate northern demands and needs.
- review relevant government policies.
- identify investment possibilities.
- outline manpower and training requirements.
- estimate capital and operating budgets.
- prepare an implementation plan.
- develop and implement a community participation model.

The plan output included:

- a complete package of data on the north
- a community participation strategy devised from public hearings held in the north.
- specific strategies for the forestry, construction industry, tourism, intermediate goods and services, minerals, agricultural, fishing industries.
- a financing strategy for Non-Treaty communities was prepared.
- housing, health, education/manpower and community infrastructure sectors had detailed proposals.

The overall capital costs were between $245-$320 million over 5 years (1976-81) with $80-$173 million accounted for by Hydro, the proposed cement plant and the pulpmill. Operating costs were projected to be $20 million annually. This is contrasted to provincial current expenditures in the north of $144 million and capital expenditures of $62 million in 1975/6. Thus, planned expenditures were not out of line with the government expenditures of the day.

The planning exercise failed for a number of reasons. They can be summarized as follows:

- Political support for the strategy did not materialize.
- The communities were not adequately involved in the exercise and eventually opposed the strategy.
- Government red tape held up implementation of the projects that were proposed despite the fact that many staff took the plan very seriously.

The next sections outline the results of the forestry, construction materials and housing technology components of the plan.

2.2.3.2 Northern Plan Forestry Component

About one third of lumber used in Manitoba comes from Manitoba forests. The alternatives are to maximize local materials use outlined below:

> "Like the mining sector, the forestry sector is characterized by the existence of an industrial enclave in which large-scale resource-extracting firms are currently operating with minimal development feedback for the Northern economy. Hence, as in the mining sector emphasis should also be placed upon manpower and employment programming to increase the participation of native northerners in the forestry complexes at The Pas and at Pine Falls.
>
> "In addition, the strategy also calls for the supply of industrial inputs required by the forestry complexes from the North, if feasible, as in the case of mining firms. However, the forestry sector is in a somewhat better position than mining with respect to increasing the community involvement in supplying the main raw material to the complexes, namely, timber. This is particularly the case in the event of expansion of capacity of the two sites. Specific opportunities are detailed below.
>
> "The nature of the forest resource in the North - the species, their small physical dimensions, and their remoteness - requires that there be close to total utilization of the harvested wood in order to maximize returns and also to spread the benefits of industry over several sites and activities. Manitoba trees are too small to be used in a plywood plant. Specifically, only about 35% of harvested wood may be used for manufacturing solid wood products, while the remainder (chips, sawdust, branches and other waste) must be utilized in fibre-using industry like pulp and paper, composite board, chemicals and so on.
>
> "The approach to planning for the utilization of the forest resource in the North has been to design regions within the forested area, to assess the forestry resource in each region, and to estimate the volume available to each community within the region on a sustainable annual cut basis and without any conflicts between communities. Where feasible, sawmilling was considered and the waste from sawmill operations taken as inputs for fibre-using plant(s) in the region.
>
> "The planning regions are as follows:
>
> 1. Lake Winnipeg Region: All communities on the east side of the lake south of an including Big Black River; all communities in the southern interlake south and east of Anama Bay. Site of Abitibi's Complex (Pine Falls).
> 2. The Pas Region: Moose Lake, The Pas, Cormorant, Wanless, Atik, Sherridon, Cranberry Portage, Ponton, Williams Lake, Herb Lake. Site of MFR (The Pas).
> 3. Northwestern Region: Pukatawagan, South Indian lake, Lynn Lake, Highrock, Granville Lake.
> 4. Western Region: All communities along the Northern Affairs boundry west of, and including, Lake St. Martin.
> 5. North Central Region: Nelson House, Split Lake, Ilford, York Landing, Pikwitonei, Thicket Portage, Wabowden, Cross Lake, Norway House.
> 6. Northeastern Region: Oxford House, God's Lake, Red Sucker Lake, Garden Hill, Sasagmack, St. Theresa Point.
>
> "Long-term (ten to twenty years), intermediate (five years or longer), and immediate (one year) plans have been developed for each region, with an increasing degree of detail. The immediate projects are summarized, by region, in the table below.

Table 2.5

Initial Forestry Projects

Region	Products/Activities	Linkages
Lake Winnipeg	pulpwood/harvesting	for Pine Falls mill
	lumber/sawmilling	for Winnipeg market
	waste/sawmilling	for Fibre-using plant
	charcoal or composite board or pulp/paper mill fibre[1] using plant	from sawmill wastes for local and regional markets
The Pas	pulpwood/harvesting	for The Pas mill; to train labour in harvesting
Northwestern	pulpwood/harvesting	for The Pas mill
	lumber/sawmilling	for Winnipeg market
North Central	pulpwood/harvesting	for The Pas mill
	lumber/sawmilling	for Winnipeg or Northern (incl. mining firms) markets
	waste/sawmilling	for new pulp and paper mill in the region
	pulp and paper/mill[1]	from sawmill wastes for export markets
Northeastern	pulpwood/harvesting	for Pine Falls mill for methanol/charcoal operation
	lumber/sawmilling	for local and Winnipeg markets
	methanol operation[1]	
Western	pulpwood/harvesting	for The Pas mill
	lumber/sawmilling	for Winnipeg market

---

[1] These fibre-using projects are five-year (not first year) projects. They depend critically on ongoing studies to analyze their feasibility.

"**Depending on the relative success of these initial projects, they may be expanded and new harvesting, sawmilling and fibre-using projects added in the intermediate planning period.** In the case of all regions, the success of projects and the rate of growth of new production will be largely dependent on the fibre-using plant(s) (established or planned), in the region, which serve(s) as a captive market for most of the product and, in addition, secures the highest value-added per unit of wood throughout. Finally, many of the recommended projects will incur losses and hence require operating subsidies in the short run, at least until regional fibre-using projects come onstream.

"**The initiation and expansion of all of the recommended projects raise some questions regarding provincial policy towards the two existing pulp and paper complexes** (e.g. stumpage rates, and displacement of present sources of supply, designated areas, allowable cut) and regarding the present quota system. These problems will have to be carefully worked out. In addition, there could be severe conflicts over resource allocation depending on the province's plans for parks development. The regions most probably affected are the Lake Winnipeg and Western regions.

"**The expansion of the forestry sector is severely constrained in particular regions and communities by the inadequacy (or total unavailability) of transportation and of energy.** Where they exist, these bottlenecks have been clearly underlined.

"**In conclusion, the forestry sector should be emphasized in the overall industrial strategy since, in many ways, it has the most potential for community and convergent development.** However, in order to realize this potential, it is necessary to undertake further careful, integrated and comprehensive planning in order to maintain an adequate data base and maximize the return on the resource." (pp. 16-20)[1]

2.2.3.3 Construction and Construction Materials Component

This component is cited from the plan as follows:

"**The sector is particularly important in the plan strategy.** Production of the means to produce housing is a very necessary step toward fulfilling the critical social need for housing in the North. Production of construction materials makes the North more independent in supplying the housing market. Of course, it does nothing to solve the severe institutional problems preventing more rapid delivery of housing to the areas of greatest need: it is also necessary to eliminate these problems as quickly as possible.

---

[1] Industry Working Group Industrial Plan for Northern Manitoba (1976-81) Industry Working Group (January, 1976).

> "In spite of the availability of a large unemployed labour force and of raw material resources in the North; these have historically been utilized only to a limited degree in the provision of inputs required by the construction industry.
>
> "The strategy in this sector is parallel to that in Intermediate Goods: **raw materials are to be processed** to produce construction materials on the one hand, and the construction industry is to seek **local inputs** for its requirements. For labour inputs, and especially in the largescale capital projects of Manitoba Hydro, this calls for **manpower programming**; for material inputs, active **government purchasing and subsidy policies** to support the establishment of new construction materials industries in the North. The strategy applies to both residential and non-residential construction.
>
> "In non-residential construction, and particularly in the case of capital construction projects, increasing the proportion of inputs supplied from the North can add substantially to the flow of income and expenditures in the Northern economy. For example, if even a small proportion of Manitoba Hydro's capital expenditures of $200-$400 million were diverted to the North, the effect on Northern industry and economy would be noteworthy.

The following projects may be implemented within the first year of the Plan.

Table 2.6

Construction Projects - First Year

Possible Locations	Products/Activities	Linkages
Cross Lake, Wabowden or Jenpeg	Doors, windows cabinets and flooring manufacturing	Output to Northern Housing and cottage plants and other construction. Inputs from local sawmills.
Nelson House or elsewhere	Trusses and Stair manufacturing	As above
Mafeking or The Pas	Concrete products manufacturing (primarily blocks and weeping tiles)	Cement supplied by Northern Plant. Aggregates locally. For Northern commercial and infrastructural construction.
Possibly Wanipigow plus Northern locations	Cottage and cabin construction. One or more RTM sites, plus on-site construction	Component (windows, doors) supplies from other plants
Location near a planned sawmill	Dimension lumber, shiplap, and finishing (siding) materials manufacturing	Supplied by sawmill, supply to housing, cottaging plants and other construction
Oxford House or Pas God's Lake Narrows	Park furniture manufacturing (incl. privies)	Supply from a local sawmill. Supply to provincial parks

> "Considerable thought has been devoted to the implementation details of these projects, as they are all planned to be commissioned during the first year.
>
> "Three areas for five-year projects are recommended. These pertain to aggregates development, Manitoba Hydro's capital projects, and to commercial and public buildings. Ongoing studies are to bring forward particular project possibilities in all three areas." (pp. 25-27 Plan)

In addition, wholesaling of building materials in the north was discussed. There appeared to be an opportunity in the north in this area.

2.2.3.4 Innovative Use of Housing Technology in Northern Manitoba

Mr. K. Nimpumo, in To Build in Northern Manitoba, discusses the options of on-site construction and the 'Ready-to-Move' (RTM) prefabrication plant. Nimpumo suggests that:

> "**Prefabrication has the advantage that a large number of identical elements can be produced by the same workers under controlled conditions.** Indoor manufacturing and the long production series increase efficiency and quality of product and reduces the amount of waste.

"Prefabrication in the building industry comes in many shapes and forms from the manufacturing of complete houses to the production of ready made doors.

"**The production of components has the advantage that a uniform and efficient production can be achieved with a limited need of skills, machinery and raw material.** This is, however, only feasible if a sufficiently large and lasting market can be created. One of the means to achieve this is a high degree of standardization and modular design. This would allow for the use of a component throughout the same building and in many different buildings." (Chapter C, p. 3)

While the RTM seemed to be functioning well, Nimpumo notes that:

"**In a longer perspective the RTM method is not satisfactory because of the use of imported material and the poor climatic design.** The first step in development should be the production of components which can be made of local materials and which can be used in the RTM production. Later on a different organizationof the building industry is desirable which will be based on:

1. Modular design of housing and public buildings.

2. Component production on a small scale, decentralized basis.

"This approach will satisfy the basic requirements of the Northern Plan:

- the use of local material,
- production possibilities in remote communities." (Chapter C, p. 4)

The prefabricated components suggested by Nimpumo are as follows:

"• **The Sanitary Wall** - The concept of the sanitary wall has been a successful way of eliminating this bottleneck from the on-site production. The idea is to produce a wall - usually a partition between the kitchen and bathroom - which already contains all the major water, sewage, electrical and heating connections." (p. 6)

"• **Sandwich Panels** - The main materials for such panels are sawn timber for the frame with timber boards, gypsum boards, plywood and hardboard sidings. The insulation material can be wood chips with foam or gypsum stabilizers or glass fibre." (p. 8)

"• **Peat moss panels** - The raw material is heated and pressed with fire retardants and binding resin to soft panels with high insulation value to produce hardboard-like panels. Small scale plants can therefore be established to serve the local construction industry." (p. 9)

"• **Wood Fibre Concrete** - Finland and Sweden have produced a considerable body of research concerning the use of bark or wood chips as aggregate in concrete. Production would be organized as a small scale operation and geared towards a panellized construction system." (p. 11)

In addition Nimpumo offers log walls, stackwall and stabilized soil walls as construction options.

Finally Nimpumo offers a Canadian version of the European modular (and metric) construction. He shows modular elements for walls and partitions, windows, and kitchen furniture.

2.2.4 The KTC Planning Strategy and Economic Conference (1982)

The KTC produced an economic strategy and a document for its Northern Economic Conference in 1982. The key items and issues can be found in the Conference document which is quoted below:

"• **The Development of Economic Underdevelopment**

Indian people, in days gone by, had the capability of meeting their basic needs for survival. With the coming of European settlers the Indian way of life was seriously eroded. The establishment of the fur trade had the effect of undermining the previously self-sufficient Indian economy as trading in furs created a dependence on European markets for the sale of fur products. The furs were exported in raw form, and little of the profit from the fur trade was retained in the north for reinvestment in other economic activities. This extraction of raw resources soon extended into other endeavours, such as mining and forestry. This economic policy, while benefiting the few, created a serious problem of underdevelopment for the large number of native northern residents." (p. 8)

"• **The Treaties Guaranteed Easy Access to Northern Resources**

"**The signing of the Treaties with the Indian people was necessary so that the extraction of northern resources could take place in a relatively unimpeded fashion.** Treaties also permitted the new territories in western Canada to be settled by European immigrants in an expedient way. This settlement policy helped to prevent the American encroachment of these resource-rich territories.

"Embodied in the Treaties is the recognition that the Chief and Council constituted a governmental authority, having responsibilities the same as any government.

"The trust and responsibility for administering the Treaties between Indian governments and the British Crown was given by the Crown to the Federal Government of Canada. Part of the Treaty obligations included the eventual settling of claims to land and resources by the Indian people now based in the Reserve communities throughout Manitoba and Canada.

"The settling of the claims to land and resources between the Indian people and the Crown in right of the Federal Government gives rights to resource extraction gives development to Indian people. But a settling of land claims alone cannot solve nor undo the serious inequities that have developed over centuries.

"What is needed is a northern development strategy that involves native and non-native northern residents alike." (p. 8)

"• **The Approach to the Strategy**

"The basic premise behind a Northern Manitoba Economic Development Strategy is that more of what is consumed locally must be produced locally. **Resources that are extracted in the north must be processed to the greatest extent possible before being sent south.** The intention of this strategy is to decide what can be realistically accomplished to promote the self-reliance of northerners. The process has begun already with the development, assisted by government, of retail stores, small manufacturing and other enterprises." (p. 12)

"• **The Tasks Ahead**

"The specific tasks that must be undertaken are suggested below.
- The preparation and implementation of an Enterprise Development Plan.
- The recognition of Thompson as a regional centre.
- The use of companies like NICO - The Northern Indian Company - to promote and organize joint ventures between northern and southern development interests.
- The establishment of a Northern Banking System.
- The development of an economic planning capacity in the native communities." (p. 12)

2.2.5 The Current Housing Delivery System

Currently housing in the north is supplied by suppliers such as McMunn and Yates, Norseman Enterprises, Wa Wa Taik Building Supplies, Dominion Lumber, Springhill Lumber, Poulet Building Supplies and Beaver Lumber. All offer a complete design and construction package that is within DIAND's subsidy housing guidelines. Some provide CMHC 56.1 Houses as well. The Houses are generally of conventional construction with foundations designed according to the site conditions. All use local labour but little or no local materials. There has been some discussion about the installation of a common kiln in Thompson to permit the various bands around Thompson to dry and store their sawn dimensional lumber (such as Nelson House) but there has been little movement on this idea to date.

2.2.6 The Canada - Manitoba Northern Development Agreement (NDA) (1984)

The Canada Manitoba Northern Development Agreement (NDA) is a co-operative federal/provincial program designed to meet a number of objectives including

- the development of income and employment opportunities.
- the facilitation of increased participation of the northern labour force in local and regional development.
- the increasing of northern development by removing physical barriers to human and economic development.

The Design Team spoke with Mr. R. McKenzie of the NDA to develop an understanding of the program which is summarized in Table 2.7. In contract with the 1976 Northern Plan prepared for the previous 5 year Agreement, there is no "grand strategy" for this present 5 year Agreement. Rather, Mr. McKenzie indicated that regions take responsibility for devising their own strategies and proposing their own projects in a manner that is consistent with the criteria of the programs outlined in Table 2.7.

Mr. McKenzie noted that there has been some movement towards the utilization of local materials for housing. Reserve communities such as Cross Lake, Shamattawa, Nelson House and Fisher Branch all have sawmills. However, none has access to a kiln. Reliance is on air drying which may result in a lower quality product if not done properly. A common kiln located in Thompson to be used by the surrounding communities was discussed but Mr. McKenzie said he preferred to see a portable kiln that could be moved from community to community.

Not all of the mills are being used to the fullest. For example, Cross Lake's lumber can not be used in housing programs because the Band does not have a grader to grade the lumber. This lumber is sold to INCO for their mine construction projects underground.

Mr. McKenzie noted that some of the Bands are developing strategies for forest product production. The Island Lake Tribal Council, for example, has prepared a comprehensive forest products strategy. the KTC is looking at a similar strategy. The Camperville Development Corporation is developing house designs constructed from squared poplar obtained locally. Oxford House looked at a mill but found that it was cheeper to import dimension lumber from Winnipeg.

Overall, it would appear that some effort to maximize use of local building materials is being explored or actively underway. The Design Team must therefore be sensitive to this fact when considering the final house designs.

Table 2.7

Northern Development Agreement — Sectors and Programs

SECTOR A —	**Community Economic Development ($47.5 million)**
Program 1 —	**Community/Regional Economic Development Planning ($2.5 million)**
Objective:	to assist local and regional groups/organizations in the identification and development of new employment opportunities.
Program 2 —	**Resource Opportunity Development ($12 million)**
Objective:	to stimulate and respond to locally developed economic development projects which create new income and employment opportunities, particularly those utilizing local and regional resources.
Program 3 —	**Northeast Manitoba Development ($2.5 million)**
Objective:	to implement special development measures in this area by focussing on its unique socioeconomic conditions.
Program 4 —	**Resource Development ($25 million)**
Objective:	to assist development activities relating to northern resources, such as forestry, parks, wildlife, and agriculture and to improve utilization and management of natural resources while providing employment opportunities for northern residents.
Program 5 —	**Local Government Development ($5.5 million)**
Objective:	to provide information services, training programs, and other developmental assistance to support local government capabilities in communities, under the guidelines of the Department of Northern Affairs.
SECTOR B —	**Human Development ($104.7 million)**
Program 6 —	**Canada Career Opportunities ($2.4 million)**
Objective:	to train indigenous Manitoba residents for employment in technical positions in Canada's public service.
Program 7 —	**Canada Employment Program and Services ($40 million)**
Objective:	to provide employment development and related manpower services in order to increase participation in economic development opportunities.
Program 8 —	**Indian Professional Development ($10.2 million)**
Objective:	to assist Status Indian people in obtaining post-secondary education, occupational skills, and management/administrative training.
Program 9 —	**Northern Manitoba Affirmative Action ($41.7 million)**
Objective:	to increase the participation of northerners, particularly those of native ancestry, in technical, professional, para-professional and resource based opportunities.
Program 10 —	**Relocation and Support Services ($6.7 million)**
Objective:	to assist northern residents to relocate to job opportunities and to provide related job and family support services.
Program 11 —	**Youth Development ($3.7 million)**
Objective:	to provide opportunities for young northerners to participate in developmental activities which will prepare them for employment.
SECTOR C —	**Community Improvement ($27.3 million)**
Program 12 —	**Community Services for Northern Indian Communities ($12 million)**
Objective:	to provide basic community services which may include community roads, safe water supply, waste management, fire prevention and protection, and public works facilities for northern Indian Reserves and Status Indian communities.
Program 13 —	**Community Services for Northern Provincial Communities ($12 million)**
Objective:	to provide basic community services for communities under the jurisdiction of the Manitoba Department of Northern Affairs, which may include: community roads, safe water supply, waste management, fire prevention and protection, and public works facilities.
Program 14 —	**Remote Airstrips ($3.3 million)**
Objective:	to provide airstrips and related facilities to improve the movement of people, goods and services for selected remote northern communities which do not have adequate or alternate transportation.

III. REVIEW OF NORTHERN HOUSING FROM AN ARCHITECTURAL PERSPECTIVE

In this review of northern residential architecture, studies and examples of house design have been chosen from such sources as the Manitoba Housing and Renewal Corporation (MHRC), Canadian Mortgage and Housing Corp. (CMHC), Department of Indian & Northern Affairs (DIAND), Quebec Indians and the Arctic region (Alaska, Yukon and the Northwest Territories). In addition, the Design Team reviewed log housing as well as the designs supplied by local Manitoba building materials suppliers. While not an exhaustive review of all the material available pertaining to the complex topic of remote house design, the designs chosen are meant to provide a cross section of the work which has been completed to date. Each design is evaluated according to its functional consideration (space allocation and relationships), its social aspects (suitability to the 'northern lifestyle'), building system (complexity, innovation, etc.) and its mechanical systems (heating, ventilating and waste disposal). **As can be expected, there is not one ideal solution to dealing with remote northern housing,** but it is intended that the designs that will be proposed address the issues where problems have been expressed, and incorporate the ideas which have already proven themselves to be beneficial.

3.1 Government of the Province of Manitoba

3.1.1 Background

During the late 1960's, the Manitoba Metis Federation (MMF) approached the Manitoba Housing and Renewal Corporation (MHRC) with a proposal that the Corporation adopt a northern housing program similar to the one operating in Saskatchewan. In February, 1969, the Remote Housing Program was established in Manitoba when an agreement was reached between the MMF, MHRC, and the Central Mortgage and Housing Corporation (CMHC). Between 1969 and 1971, the construction and mortgaging of 100 houses was accomplished. The MMF requested, and received, the responsibility for the distribution of the new houses to northern communities, a responsibility it held until 1971. The capital cost of the program was shared 75%-25% between the federal (CMHC) and provincial (MHRC) governments, with MHRC being responsible for the construction of the houses, and other related functions.

In 1971-1972, the Remote Housing Program was expanded to allow for the construction of an additional 100 houses, thus doubling the previous yearly output of the program. An agreement was reached between MHRC and the Manitoba Department of Northern Affairs in which Northern Affairs accepted full responsibility for the administration of the program, while MHRC provided technical advice and periodic inspections. Also in 1971, a Remote Housing Committee was formed as an advisory body. It provided an outline for the distribution of the houses among 30 or more communities scattered across northern Manitoba. This committee consisted of one member from each of Northern Affairs, MHRC, MMF, Northern Association of Community Councils (NACC), and the Department of Health and Social Development. MHRC reserved the right, however, of vetoing the decisions reached by the committee. Additional allotments of 102 houses in 1972-73 and of 200 houses in 1973-74 were constructed.

During March, 1974, an internal report entitled A Review of the Remote Housing Program was prepared. This report reviewed the history of the program, and examined such topics as the problems involved with land acquisition, planning of community subdivisions on site stick built house construction as opposed to centralized "Ready-to-Move" house construction, administration responsibilities, and a description of the house design currently being used in the program. Included among the several recommendations made at the conclusion of the report were:

> "A more useful training component should be introduced into the on site construction method to be more beneficial to workers and to help improve the quality of houses built on site.
>
> "Alternate house designs should be introduced into the program.
>
> "Appropriation of housing units to remote communities should be made earlier to take advantage of winter roads to ship material.
>
> "Support services and improved tenant information services are required to help tenants adjust to a new type of shelter and to explain program requirements."(pp. 47-50)[1]

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[1] B. Bingeman, K. Cassin, J. Glassco, A Review of the Remote Housing Program, March 1974.

By 1977-78, the Northern Association of Community Councils had dropped out of the Remote Housing Committee, thus leaving the responsibility for the delivery of houses to the MMF, and the MHRC. At this time, the bulk of the houses were delivered of MMF while MHRC delivered the remainder while also providing technical advice. The emphasis of the program was shifting to Indian communities in southern areas of the province instead of the northern.

In early 1980, the MMF had assumed complete responsibility for the delivery of the houses.

3.1.2 General Architectural Information on the MHRC Houses

Throughout the 1969-1974 period of the Remote Housing Program, there was only one floor plan used, this being an adaption of the design used in the Saskatchewan program. Due to the extremely urgent need for housing in northern communities because of overcrowding, health problems and safety deficiencies, the initial emphasis of the program was to produce. A "concentration on delivery rather than on a long and careful study of the exact ideal qualities of a design was made." (p. 52)[1]

By the end of 1974, the immediate need for housing was somewhat alleviated, allowing more time to be spent on providing alternate design solutions. In 1975, the program was expanded to include several larger floor plans to help need the changing needs and desires of the people.

3.1.3 Floor Plans, Elevations, Sections and Perspectives of MHRC Houses

Figure 3.1 is the standard remote house floor plan adapted from a plan used in the Saskatchewan housing program.

Figures 3.2, 3.3, 3.4 and 3.5 are examples of the expanded floor plans provided by MHRC in 1975-76.

3.1.4 Functional Considerations

The standard remote house design (Fig. 3.1) is described within the 1974 Remote Housing Program review as follows:

> "The house is a three bedroom bungalow without a basement, enclosing about 800 square feet of space . . . The layout of the house is quite conventional, with a 150 square foot living room adjoining an approximately 140 square foot kitchen-dining room. Two medium sized and one small bedroom share the other half of the plan. Two unusual features are the approximately 40 square foot utility room that could be used later on as a bathroom as well as a recently added cold porch of about the same size providing an air lock entry."[1]

This standard design incorporates a very efficient use of space, but, due to its small floor area, limitations are created. There has been no distinction made between private and public areas within the house. This creates a potential conflict between different activities often occurring at the same time; for example, the need of quiet areas for study or for sleep as well as areas for socialization and recreation. In large families, there is greater opportunity for this conflict to occur. It becomes difficult for children to find quiet study areas, while the other daily activities take place within the house.

Another problem inherent with the small floor area is the lack of adequate storage space. Besides the clothes closets in the bedrooms and by the side entrance, there is little other space devoted solely to storage. The addition of the combined mud room/cold storage area has helped to improve the situation. The utility room (which may be converted into a bathroom) can be used as a storage area.

Figures 3.2 and 3.3 are 2 and 3 bedroom single storey bungalows with floor areas of 672 square feet and 912 square feet respectively. In both designs, the daily living area (kitchen, dining room, living room) is centralized with bedrooms and storage areas flanking it on either side. In the smaller of the two plans, a feeling of spaciousness is created through the use of an unobstructed view between the kitchen, dining and living rooms. This feeling of spaciousness is lost in the larger, three bedroom, version, as a partition has been placed between the living and dining/kitchen areas. This wall creates a physical division between the different activities taking place within this centralized area. Both plans still suffer from the same lack of definition between public and private areas as does the standard plan discussed earlier, although the three bedroom version is an improvement in that it does not allow for the bedrooms to be directly entered from the living area. Also similar to the standard plan, both of the updated bungalows incorporate utility rooms next to an exit from the house. These rooms may also be used as bathrooms. All doors leading to the exterior open into vestibules and/or mudrooms incorporated into the floor plan. Hence they do not appear as afterthoughts in the design process. Besides the adequate closet space to be found in the bedrooms and in the kitchen, there is also a 60 to 70 square foot storage room entered from the vestibule. No work or hobby area has been provided.

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[1] Nimpuno, K., To Build in Northern Manitoba, A Report to the Government of Manitoba (Arkplan AB), January, 1976.

[1] Bingeman, et al, p. 7-8.

Figures 3.4 and 3.5 are two and three bedroom bi-levels with floor areas of 1,536 square feet and 1,920 square feet respectively. In both plans, the bathroom and the staircase separate the public areas on one side and the private areas on the other. This buffer zone between the two helps to establish quiet areas within the house for studying and for sleeping without interruption from noisier activities taking place in the living areas. Also common to both plans is that the living room is separated from the dining/kitchen area by a waist high wall. This provides a physical separation between different activity areas, while at the same time maintaining a feeling of spaciousness within the 24' wide houses. Since both of these plans also include full basements, there is allowance for plenty of storage space, as well as room for additional bedrooms as the family grows larger. There is only one entrance provided to these buildings and both use the landing between the basement and first floor as a mud room, but not as a vestibule. Due to the landing being lower than the first floor, no drafts should be evident in the living areas, but there is a good chance that drafts will occur on the basement level whenever the entrance door is used.

3.1.5 Social Considerations of the MHRC Designs

Indian tradition had established that a house was an unobstructed space enclosed by four walls and a roof. Within this dwelling all of the family's daily activities took place. It had no moisture problems, was usually well heated (although it did require a lot of fuel to keep it so), and it fulfilled all of the families' needs. With the implementation of the Remote Housing Program, a new type of lifestyle inherent with the typical three bedroom suburban bungalow, was introduced. What was once unobstructed space within their old dwellings, is now partitioned into a series of separate rooms within the new houses being supplied. This "new" environment was initially met with opposition, with some homeowners attempting to create an atmosphere of familiarity by tearing down the partitions and using them as kindling.

Eventually through experience with the new designs and an ever increasing contact with the southern region of the province, the subdivided plan became the norm. Few homeowners are now willing to return to the unobstructed plan concept used before. The availability of privacy was now an important desire in their life. As the first winter set in, several problems previously unexperienced by the homeowners in their old dwellings gradually became evident. The bedrooms were difficult to heat by a centralized wood stove due to the subdivided nature of the plan, and because of another tradition of constantly heating water on the stove, the tighter houses created higher humidity levels which caused windows to be constantly covered in ice and entrance doors to warp and freeze shut. This water vapour soon found its way into the structure of the house and condensed in the wall system. Decay soon set it.

As mentioned earlier, the initial emphasis of the program was to produce houses as quickly as possible. A design which made efficient use of space, involved straightforward construction techniques and is inexpensive to build was required, and hence the adoption of the standard remote house plan. Despite its being able to meet these requirements, other problems, besides moisture buildup and the difficulty to evenly heat, were encountered. Besides the lack of adequate storage space, there was also no means by which to accommodate large families without creating overcrowding. This one design had to provide housing for anywhere between 3 to 13 people at a time; providing space for work, storage, study, sleep, social activities, etc. Great stress has been placed both upon the house structure which was not designed to withstand such large occupancy loads, and within the family unit whose members have acquired an increased desire for privacy.

With the addition of the two bungalow and two bi-level plans in 1975, 1976, a choice was made available to the potential homeowners. They could now choose a size and style of house to meet their family's needs, while still maintaining the use of straightforward construction techniques to allow the houses to be built inexpensively while using local labour.

3.1.6 A Review of The Building System

As explained in the 1974 Remote Housing Program Review, the standard remote house,

> "sits on a low foundation wall of reinforced concrete that is placed on a footing at the original ground level. The standard 2" x 4" wood frame is clad with plywood panels and roofed with ashphalt shingles. The interior walls are of grooved prefinished hardboard. The floors throughout are covered with vinyl asbestos tile and the ceiling is of smooth while ceiling tile."[1]

3.1.6.1 Wall and Flooring Systems

The walls are insulated using R12 fibreglass bolts and the attic is insulated to R20 using loose insulation such as cellulose. The floor is or is not insulated depending on what type of foundation was used. The standard strip foundation is suitable for use in non-permafrost forested and open sites, but it has been discovered that if a crawlspace is completely skirted in with no allowance for ventilation, severe heaving occurs due to the uneven freezing and thawing of the surrounding soil. This problem was further compounded by the fact that the homeowner could not be relied upon to perform any essential maintenance on the house, such as periodic adjustments of the supporting teleposts located under the house which would help alleviate the effects of the heaving. This heaving resulted in unlevel floors, partitions separating from ceilings, and at times severe structural damage (such as large cracks in exterior walls).

Towards the mid to late seventies, as the updated designs were introduced, experimentation with different construction techniques took place. The plans called for 2" x 6" walls instead of 2" x 4" walls, thus allowing R20 glass fibre batt insulation to be used. The attic was insulated with an additional R20, to give it a total of R40. Floors (in designs with crawl spaces) were insulated to at least R20 in an attempt to prevent the cold floors experienced in past houses built within the remote housing program. The designs utilizing full basements (such as the two bi-levels being discussed) were adequate in northern communities where there is no intermittent permafrost, but they have also provided to be economically unfeasibible to build and costly to heat in the remote communities.

To help lessen the problem of heaving, clear span prefabricated steel beams were used in lieu of the original wood beam and telepost system. This allowed the house to be supported at two ends, thus if shifting should occur, it would be distributed more evenly throughout the structure. Originally a 12" truss was used. This created a bouncing floor problem so an 18" truss was used instead.

3.1.6.2 The Construction Methods Used

In delivering the houses, two construction techniques were used; these being the on-site "stick built" method, and the "Ready-to-Move" (RTM) method. The on-site "stick built" method begins with initial site preparation and foundation work. After the foundation is completed, local labour constructs the house, (more often than not) using imported material. A foreman, supplied by MHRC, lives in the community and oversees the co-ordination of the projects. It is also his job to attempt to teach basic construction techniques to the locally hired workers in order to create marketable skills for future jobs in the construction industry. It also allows any money generated from the construction of the homes to remain within the community. It is noted that:

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[1] Ibid p. 7.

[1] Note that all values are English units not metric.

> "the general pattern of work over the course of construction starts with high initial enthusiasm and good attendance, often by more workers than one MHRC foreman can handle efficiently. Within several weeks up to 50% of the workers leave the job and absenteeism becomes more prevalent ... the amount of skills training that the unskilled worker receives on the job is negligible. It is too much to expect of one foreman to train workers while at the same time organizing the construction activities on the job site."[1]

It is still understood that the need to train workers for the construction industry is a good means of providing actual job experience to previously unskilled labour, and that this goal should coincide with the remote housing program:

> "Skills training implies the creation of an atmosphere which encourages self motivation and voluntary participation for personal improvement, hopefully with some prospects for the future."[2]

With the "RTM" operation, all of the houses are "stick built" at a central location. Once completed, they are transported to their final destinations. "The houses are built on blocks in a semicircle around an open service/storage, prefab area."[3] Under the supervision of one MHRC foreman, a group of workers are hired from the community to learn the construction trade as they build the houses. This system proves to provide more permanent employment than does the on-site method, hence there is a lesser degree of worker turnover. There is also a much higher monthly output of houses. Outlining the RTM in operation in Camperville, Manitoba, the authors of the Remote Housing Program Review state that:

> "The manpower benefits of building units at Camperville for delivery to other communities accrue mainly to Camperville ... The Camperville operation generates a higher degree of skills training and a much greater degree of permanency of employment [than does on-site 'stick-built' construction.] Thus it appears that more useful and permanent benefits accrue to Northerners from an RTM operation than from constructing units on site."[4]

Another observation that has been made of houses produced at RTM centres is that they are of a much higher quality than the majority of on-site constructed houses.

3.1.7 Mechanical Systems (Heating/Ventilation/Waste Disposal)

3.1.7.1 Heating System

All three bungalow designs allow for centralized space heaters, using either wood or oil. Provision has also been made for a forced air system if desired by the homeowner. Electric baseboard units located in each room have been suggested as a supplementary heating system. One previously mentioned complaint is that there is not adequate heat distribution throughout the house. In most cases this lack of distribution is due to furniture being located in such a way as to create dead air spaces. Beds being placed up against walls over electric baseboard heaters is one such example. A possible solution to this problem would be to provide built-in furniture which take into account air circulation but this solution could further restrict the houses already limited flexibility. No centralized space heater has been provided for in the two bi-level plans. These are probably intended to be heated by a forced air system with the furnace located in the basement.

3.1.7.2 Ventilation System

Inadequate ventilation leading to high humidity levels within the house has generated the greatest number of complaints by homeowners; a problem common to most houses in northern communities. It was first mentioned as an area of concern within the Kennedy Smith Assoc. study (Section 3.2.1) written in 1968, and it is still an area of concern today. In the typical northern Indian household, high moisture production from constantly heating water on the stove, overcrowding of the houses, hanging clothes to dry indoors, etc., has resulted in humidity levels much higher than what the houses were designed to withstand. Decay and rotting of the structural members of the house, as well as damaged interior finishes, has been created by water vapour getting past the vapour barrier and condensing within the exterior walls during winter. One attempted solution to this problem was to place an exhaust fan in the kitchen. Next to the stove was placed a humidistat controlling the operation of the fan. The moisture laden air was exhausted through ductwork located under the floor, and vented to the exterior at floor header height. It was left to the discretion of the homeowner to control the humidistat setting. During winter, the homeowner noticed that this sometimes noisy exhaust fan was a source of great heat loss; as proven by the melting snow on the ground by the exterior vent, while at the same time, he did not experience any noticeable difference to the interior environment of the house. This led to his turning the humidistat to the off position, resulting in eventual moisture build-up, frosted windows, warped doors, deteriorating interior finishes and structural decay. To bypass this tendency to shut off the ventilation system, the technical crews installed pre-set humidistats which were unaffected by turning the setting dial.

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[1] Ibid p. 13.
[2] Ibid p. 17.
[3] B. Culjat, Climate and the Built Environment of the North Printed in Sweden, 1975.
[4] Bingeman p. 17.

3.1.7.3 Waste Disposal System

As mentioned in section 3.1.4, the bathroom in Figures 3.1, 3.2 and 3.3 is located right off the main entrance. This reduces greatly the travel distance for the disposal of waste in houses using the "honey bucket" system. Sanitary conditions are maintained within the living area of the house. The kitchen sink also empties into a pail which must be carried outside and emptied. In the two bi-level designs, the bathroom is separated from the only exit from the house by a small hallway and a short flight of steps leading down to the mudroom. This distance greatly increases the risk of spillage and contamination of the house's sanitary condition. **It is the opinion of the Design Team that water born systems are both unfeasible and uneconomical because of the intermittent permafrost and extreme temperatures in northern communities.** Other methods of sewage disposal should be explored in greater detail.

3.1.8 Studies and Reports Conducted in Manitoba

There have been a series of studies and reports written about the problems/options for northern Manitoba. These are reviewed in the sections following.

3.1.8.1 Design of Remote Housing in Northern Manitoba by J. Pass

A report entitled Design of Remote Housing in Northern Manitoba was completed by Mr. J. Pass in 1974. It briefly examines the current housing conditions in northern Manitoba, provides climatic and technical design data, briefly outlines the Remote Housing Program, and finally, provides an analysis of four selected house designs (including the standard remote house plan). Both the technical design data presented, and the format upon which the design analysis was made, were derived extensively from the Kennedy/Smith study previously mentioned. Poor heat distribution, condensation, ventilation, overcrowding, cold floors, water supply, and waste disposal are all topics discussed in Mr. Pass's report. Figures 3.6 (sheets 1-3), 3.7 (sheets 1-3), and 3.8 (sheets 1-3) are three house designs along with his analysis which appears at the end of his report. These include a bungalow and 2 two-storey solutions to the northern housing design problem.

3.1.8.2 To Build in Northern Manitoba by K. Nimpuno

The report, To Build in Northern Manitoba by K. Nimpuno, was submitted in 1976 to the Province of Manitoba. It had been commissioned by the government of Manitoba. This study "seeks to describe and analyze some fundamental aspects of design and construction of buildings in Northern Manitoba, and proposes a strategy to improve its quality." (p. 2)[1] The series of recommendations proposed by the report include:

- the use of a modular co-ordination system of house prefabrication. This system utilized modularized panels derived from a similar system currently in use in Sweden. These panels would be manufactured in de-centralized, small scale workshops throughout the northern communities. The manufacture of doors, windows, cabinets, stairs, etc. would occur at the same time and would supply both the needs of existing housing, as well as be incorporated into the panel designs.

---

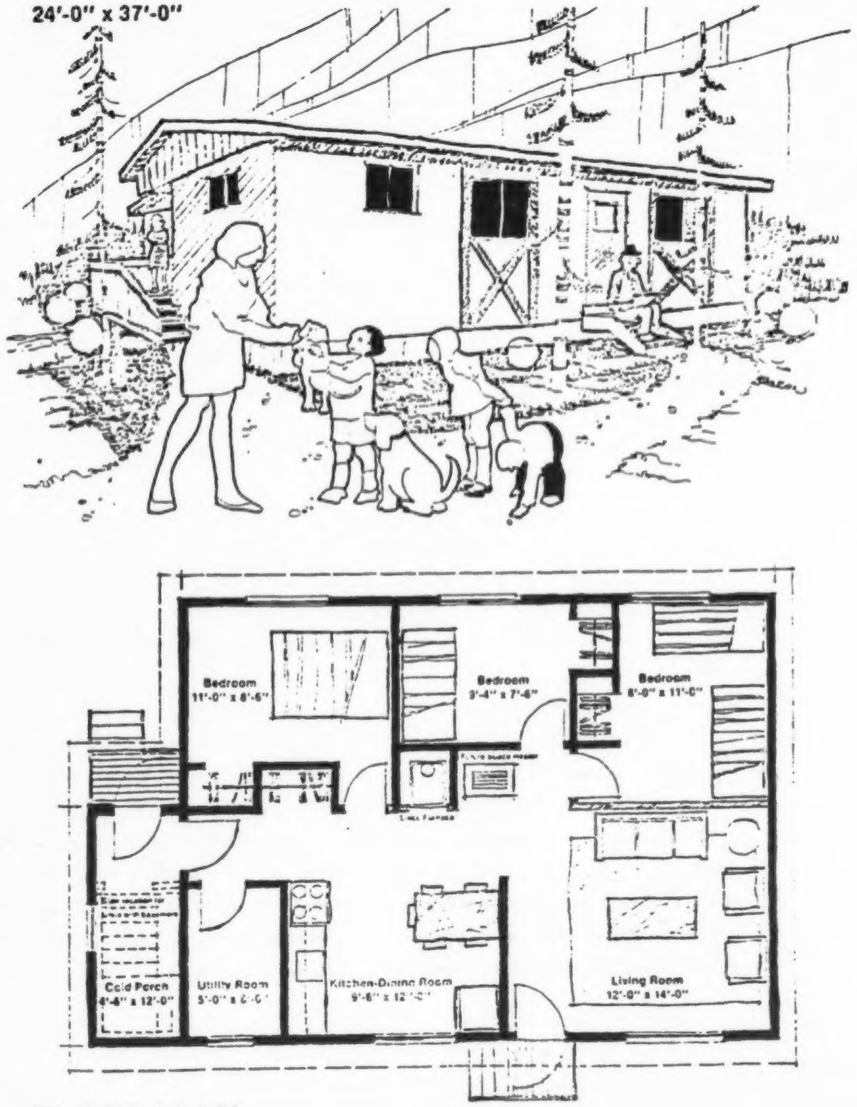
[1] Nimpuno, K., To Build in Northern Manitoba, A Report to the Government of Manitoba (Arkplan AB), January, 1976.

- That any system proposed should utilize localized labour and materials (wood, paper, wood waste, peat moss, logs) to bring the greatest economic benefit to northern communities.
- The use of either the Pack-Freeze-Compost, or the mouldering toilet systems for waste disposal.
- That the proposed construction be applied without any large administrative effort.

The main body of the report examines community development, building and the building industry in northern Manitoba, the Remote Housing Program, design for the north (once again heavily dependent upon the Kennedy/Smith study), and an extensive section dealing with an overview of all the sewage systems available for use in the remote north. This study sees the housing problem from an outsider's point of view, a shortcoming that Nimpuno freely admits. "The heavy reliance on written material, our own lack of firsthand knowledge of Canadian history and conditions constitutes clearly a serious weakness in the study",[1] but despite this, the report does provide a good perspective on what had occurred in research and development in sub-arctic housing design and technology to the end of 1975.

Figure 3.1

MHRC REMOTE R3 PLAN



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[1] Ibid p. 2.

Figure 3.2

MHRC R-1 28'-0" x 24'-0"

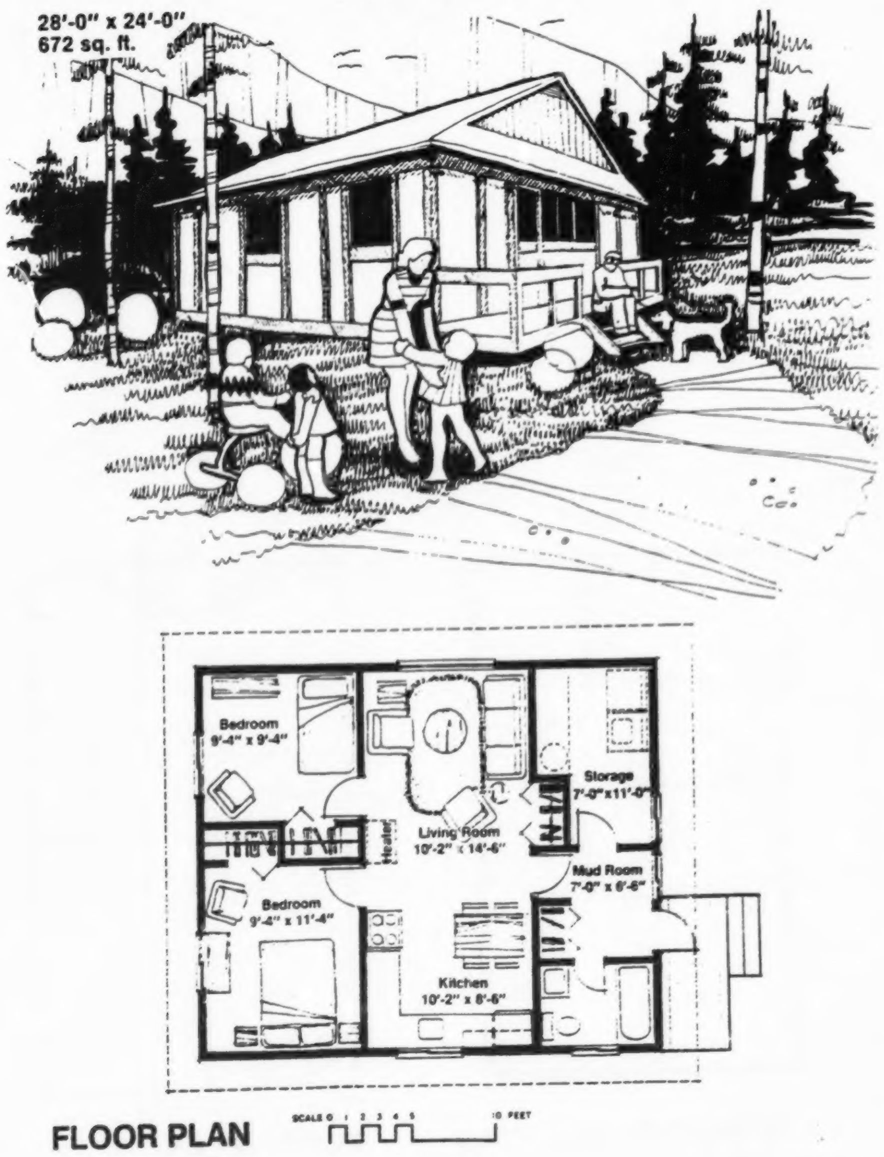

28'-0" x 24'-0"
672 sq. ft.
Bedroom
9'-4" x 9'-4"
Storage
7'-0" x 11'-0"
Heater
Living Room
10'-2" x 14'-6"
Mud Room
7'-0" x 6'-6"
Bedroom
9'-4" x 11'-4"
Kitchen
10'-2" x 8'-6"
FLOOR PLAN
SCALE 0 1 2 3 4 5 10 FEET

Figure 3.3

MHRC R-2 38'-0" x 24'-0"

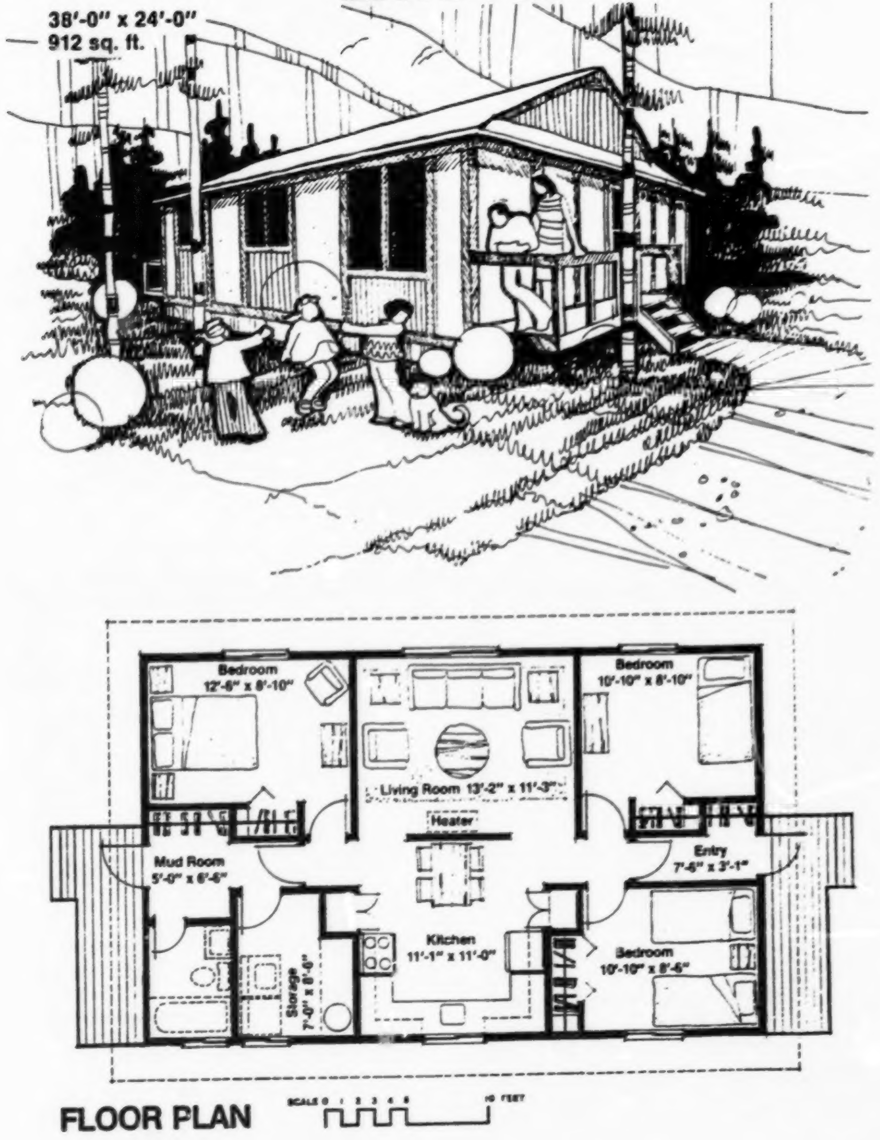

38'-0" x 24'-0"
912 sq. ft.
Bedroom
12'-6" x 8'-10"
Living Room 13'-2" x 11'-3"
Bedroom
10'-10" x 8'-10"
Heater
Mud Room
5'-0" x 6'-6"
Entry
7'-6" x 3'-1"
Storage
7'-0" x 8'-6"
Kitchen
11'-1" x 11'-0"
Bedroom
10'-10" x 8'-6"
FLOOR PLAN
SCALE 0 1 2 3 4 5 10 FEET

Figure 3.4

MHRC Bi-Level - 2 BL

24'-0" x 32'-0"

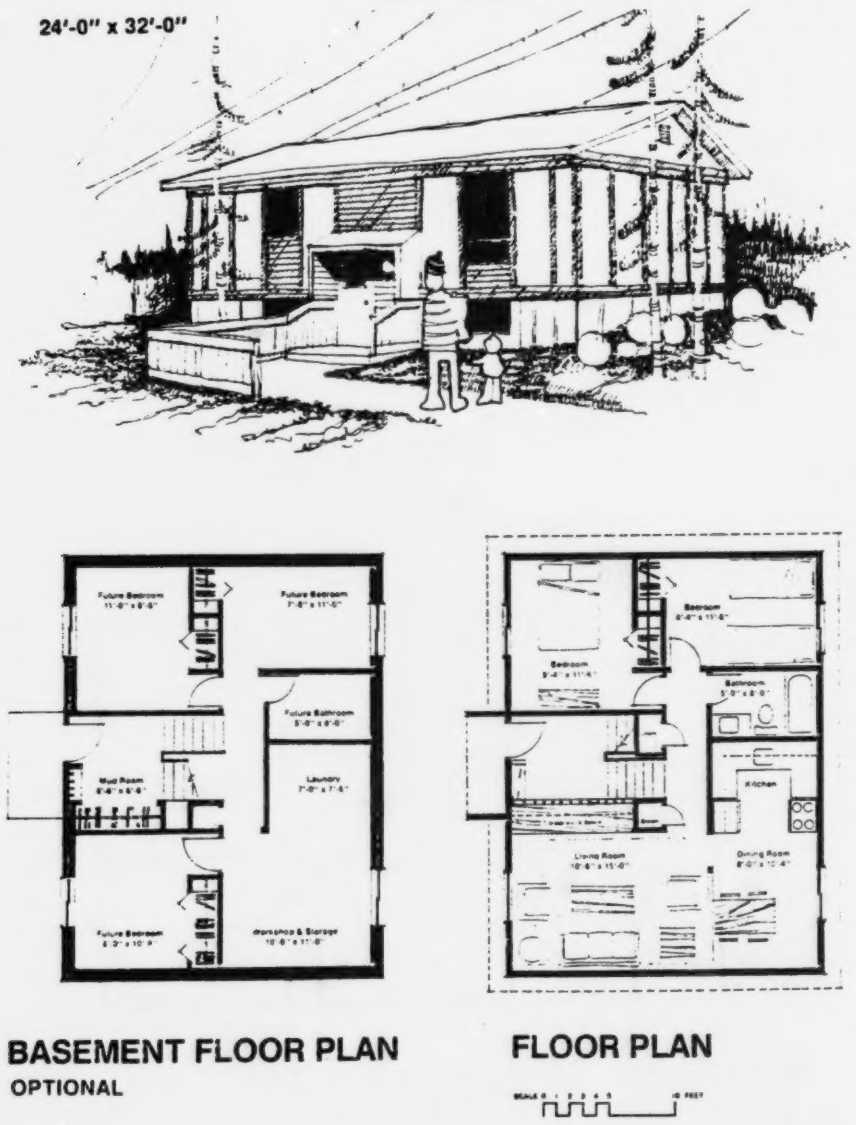

24'-0" x 32'-0"
Future Bedroom
11'-0" x 8'-6"
Future Bedroom
7'-8" x 11'-0"
Future Bathroom
5'-0" x 8'-0"
Mud Room
6'-6" x 6'-6"
Laundry
7'-0" x 7'-6"
Future Bedroom
8'-3" x 10'-8"
Workshop & Storage
10'-6" x 11'-0"
BASEMENT FLOOR PLAN
OPTIONAL
Bedroom
8'-4" x 11'-6"
Bedroom
9'-4" x 11'-6"
Bathroom
5'-0" x 8'-0"
Kitchen
Living Room
10'-6" x 15'-0"
Dining Room
8'-0" x 10'-4"
FLOOR PLAN
SCALE 0 1 2 3 4 5 10 FEET

Figure 3.5

MHRC Bi-Level 3 BL

24'-0" x 40'-0"

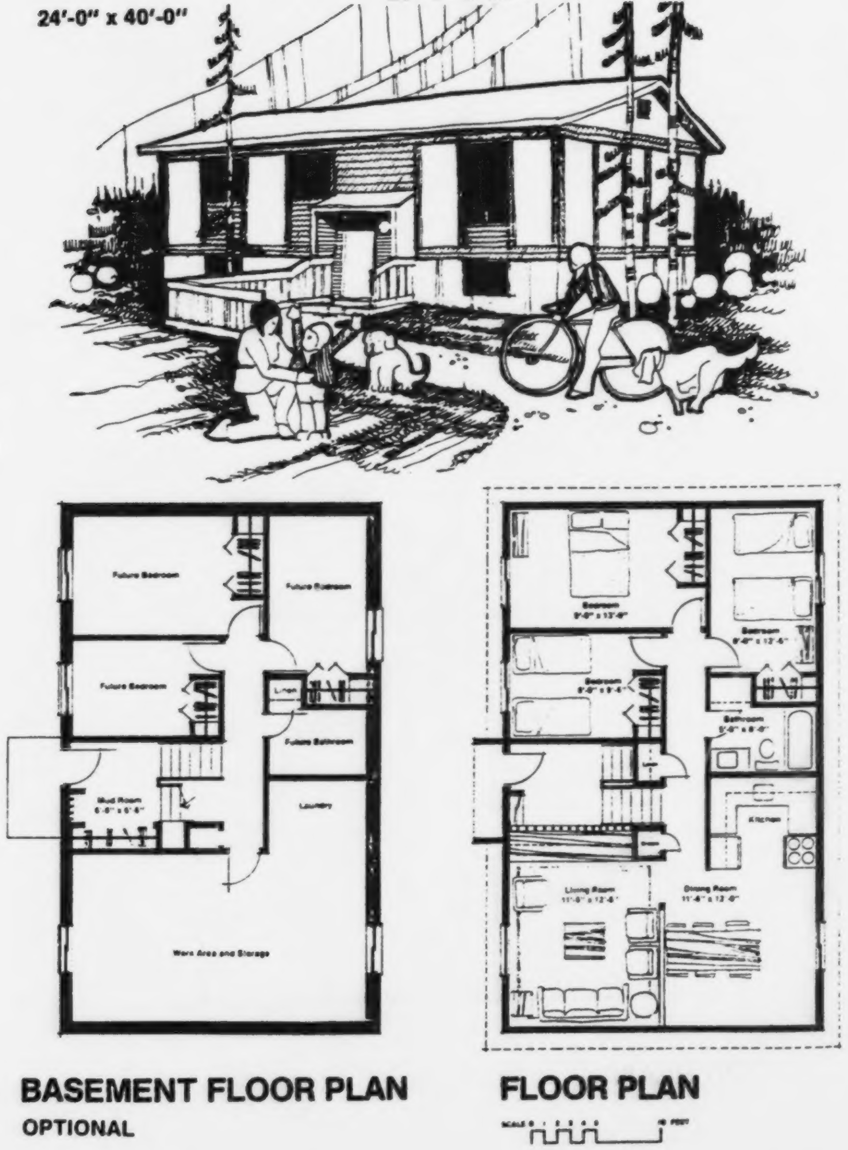

24'-0" x 40'-0"
Future Bedroom
Future Bedroom
Future Bedroom
Linen
Future Bathroom
Mud Room
6'-6" x 6'-6"
Laundry
Work Area and Storage
BASEMENT FLOOR PLAN
OPTIONAL
Bedroom
9'-0" x 13'-6"
Bedroom
9'-6" x 12'-6"
Bedroom
9'-6" x 9'-6"
Bathroom
5'-0" x 8'-0"
Kitchen
Living Room
11'-0" x 12'-6"
Dining Room
11'-6" x 12'-0"
FLOOR PLAN
SCALE 0 1 2 3 4 5 10 FEET

Figure 3.6

PASS HOUSE E1 - 2 Storey (Main Floor Plan)

(Sheet 1)

Source: J. Pass, Design of Remote Housing in Northern Manitoba, 1974.

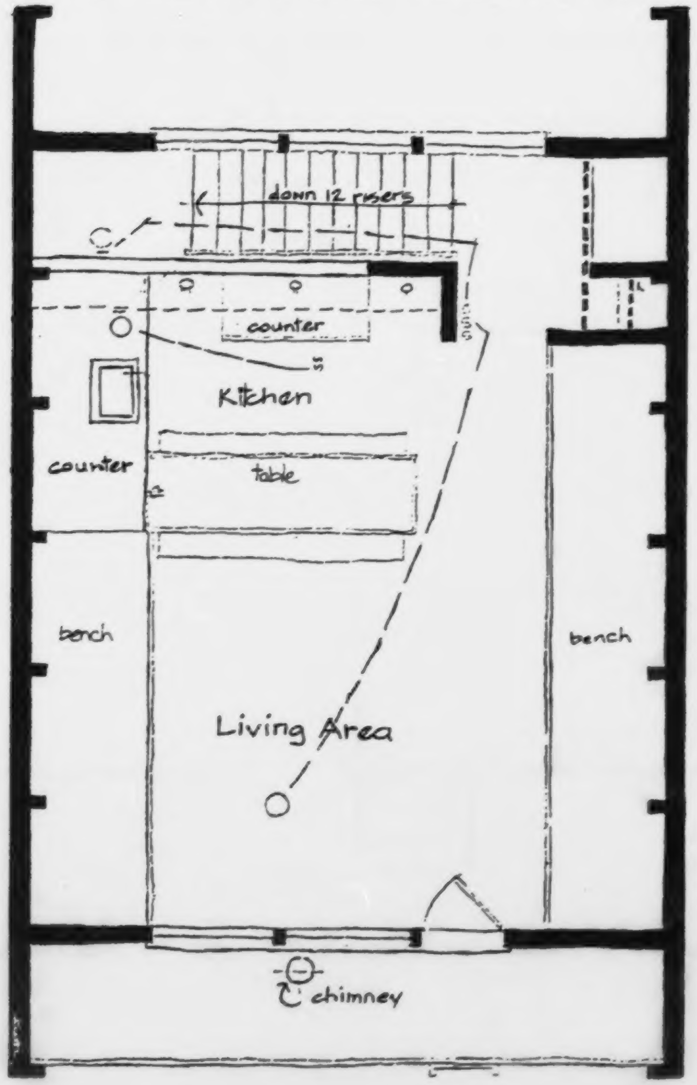

down 12 risers
counter
Kitchen
counter
table
bench
bench
Living Area
chimney

Figure 3.6

PASS HOUSE E1 - 2 Storey (Section)

(Sheet 2)

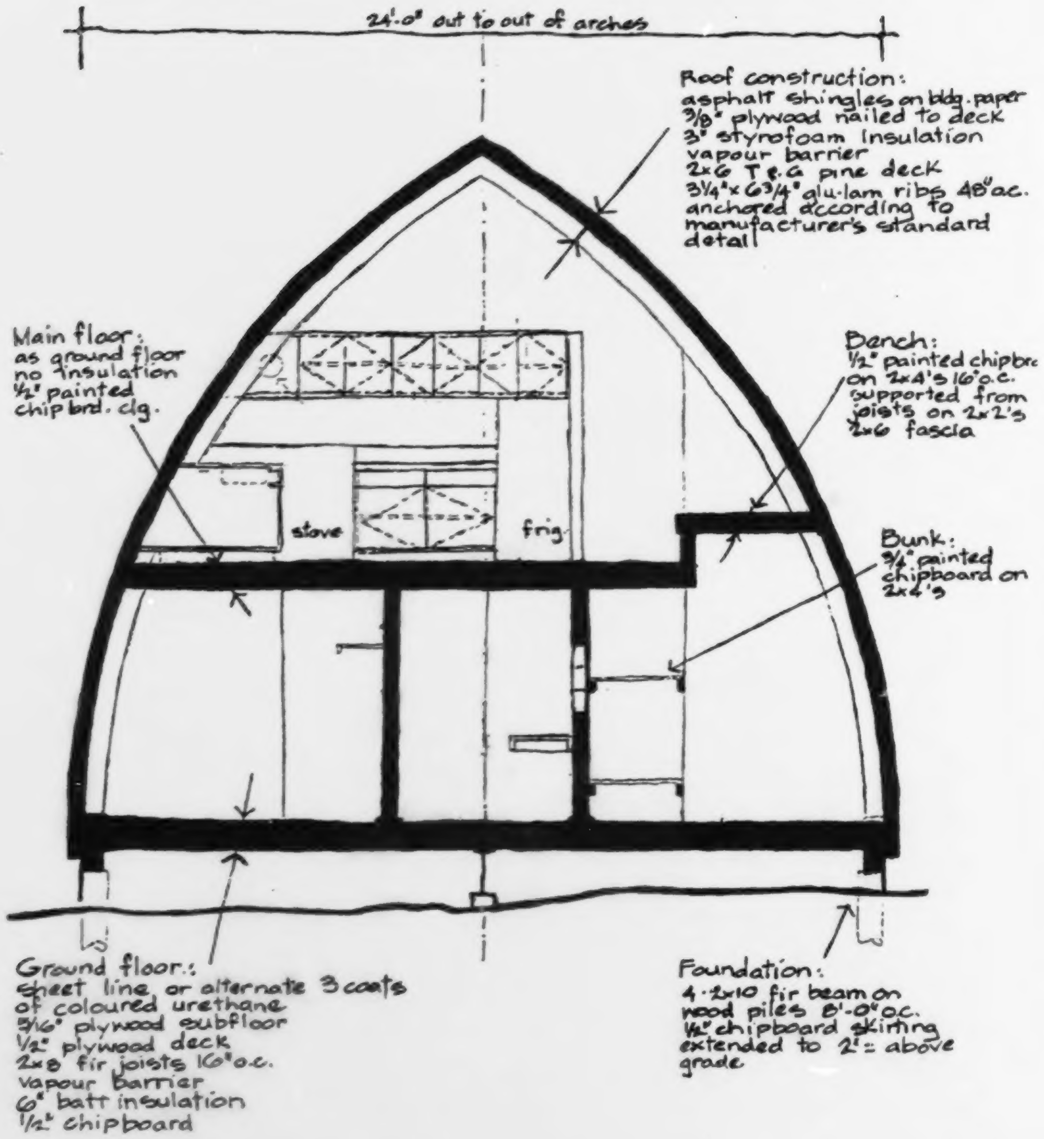

24'-0" out to out of arches
Roof construction:
asphalt shingles on bldg. paper
3/8" plywood nailed to deck
3" styrofoam insulation
vapour barrier
2x6 T&G pine deck
3¼"x 6¾" glu-lam ribs 48" o.c.
anchored according to
manufacturer's standard
detail
Main floor:
as ground floor
no insulation
½" painted
chip brd. clg.
stove
frig.
Bench:
½" painted chipbrd
on 2x4's 16" o.c.
supported from
joists on 2x2's
2x6 fascia
Bunk:
¾" painted
chipboard on
2x4's
Ground floor:
sheet line or alternate 3 coats
of coloured urethane
5/16" plywood subfloor
½" plywood deck
2x8 fir joists 16" o.c.
vapour barrier
6" batt insulation
½" chipboard
Foundation:
4-2x10 fir beam on
wood piles 8'-0" o.c.
½" chipboard skirting
extended to 2' ± above
grade

Figure 3.6

PASS HOUSE E1 - 2 Storey (Analysis)

(Sheet 3)

CHECKLIST BASED ON KENNEDY-SMITH REPORT DESIGN SUGGESTIONS

HOUSE TYPE:	E-1 2-storey
PLAN CONCEPT:	heat source centralized at lower level in plenum-type space, heated air circulates through bedrooms and up perimter walls to living space.
SITTING:	perma-frost type foundation, suitable to forested area with high snow loads, windowless arched wall/roof oriented to north or prevailing winds.
CONSTRUCTION SYSTEM:	arched glulams with decking, insulation and cedar shakes, other walls standard stud construction.
HEATING SYSTEM:	wood stove, some interior fuel storage
centralized	yes
children protected from burns	yes
chimney protected	yes, some heat loss to outside
all bedrooms heated	yes, no ducts used
air circulation at perimeter	yes
added insulation from storage	yes, one end wall only.
VENTILATION:	
cross ventilation	yes
clothes drying space	possible on balcony off living space
simple kitchen vent	louvres in end walls
double glazing	all windows
triple glazing	no
air lock entry	yes
crawlspace	yes
insulation	3" rigid wall/roof, batt in end walls and floor.
USE OF SPACE:	
living area doubles as sleeping area	possible
sleeping area used for day sitting	no, unnecessary in this plan
vestibule with adjacent storage	yes
single entry	yes
seasonally expandable spaces	balcony only
children's study space	bedrooms cannot accommodate
sheltered play space	under balcony only
hobby and work space	no
multiple use furniture	built-in benches in living space
built-in furniture	as above and bunks
movable storage units	no
water storage	not incorporated.

COMMENTS ON PLAN:

Kitchen, bathroom and WC fixtures do not align, could be a problem in future if house is to be properly serviced.

Direct access to upper floor from entry but separation of public and private areas not well-considered, possible cold drafts into bedrooms from entry.

Direct access to wood storage for heater.

Bedroom spaces long, narrow, difficult to subdivide considering that house is intended for year round occupancy.

Inflexible built-in bunks and dining table.

Kitchen and living spaces most used are furthest from entrance.

WC close to entrance, good for children playing outdoors.

Figure 3.7

PASS HOUSE E2 - 1 Storey (Floor Plan)

(Sheet 1)

Source: J. Pass, Design of Remote Housing in Northern Manitoba, 1974.

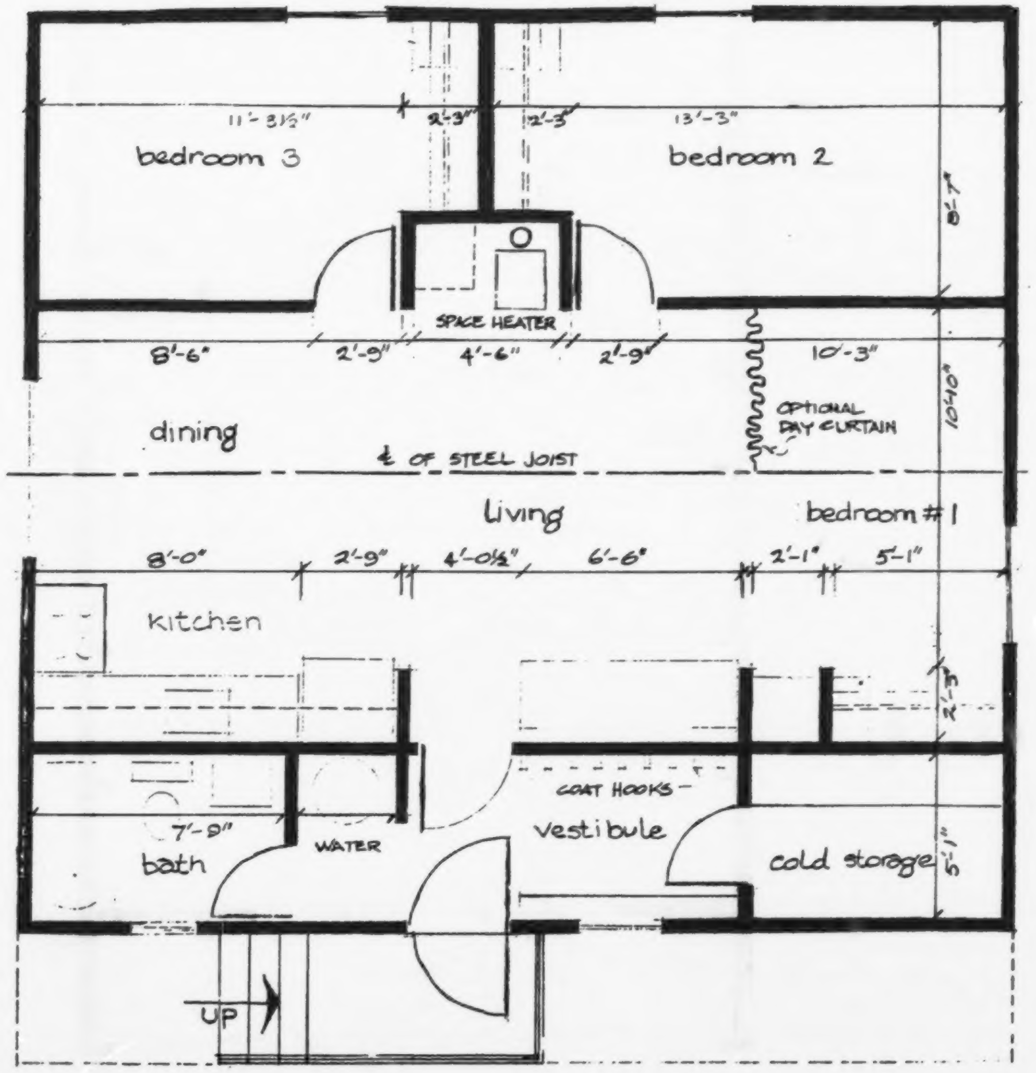


Figure 3.7

PASS HOUSE E2 - 1 Storey (Section)

(Sheet 2)

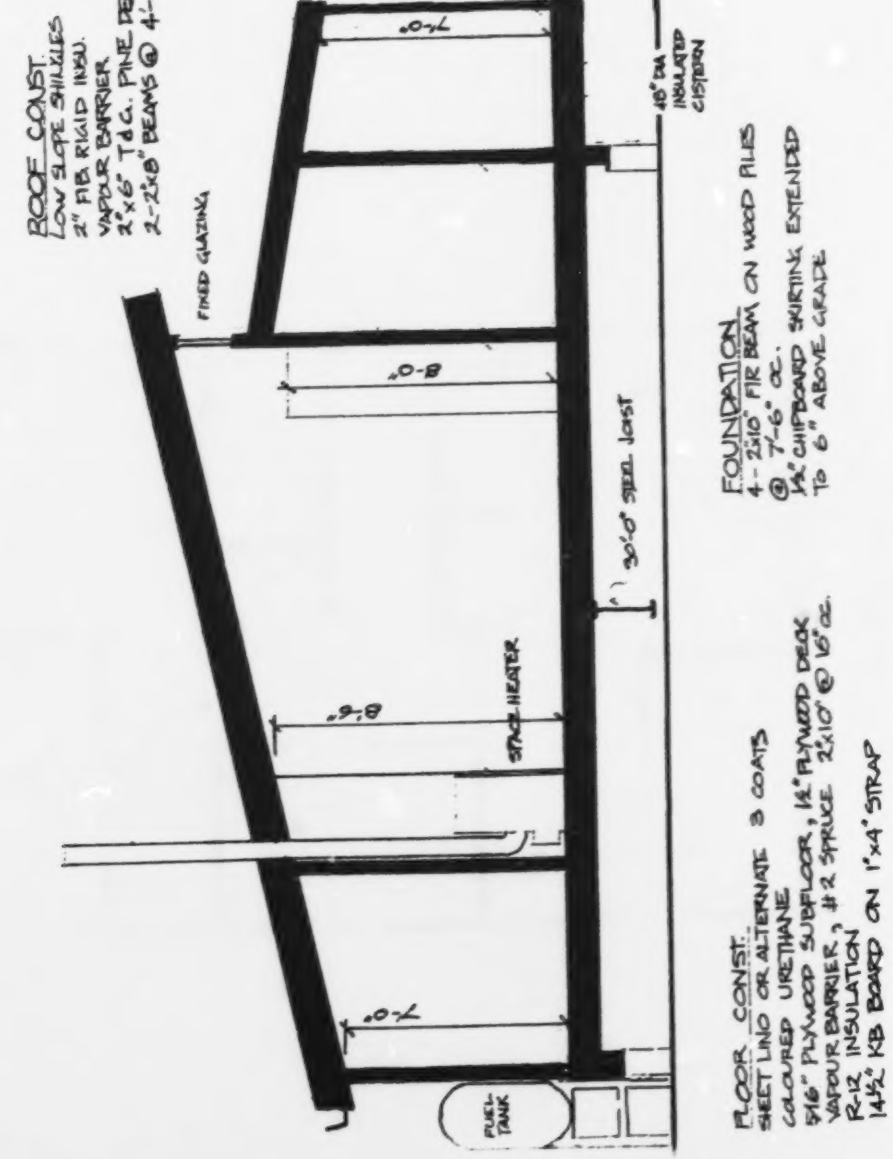

ROOF CONST.
LOW SLOPE SHINGLES
2" FIB RIGID INSU.
VAPOUR BARRIER
2"x6" T&G. PINE DECK
2-2x8" BEAMS @ 4'-0"
FIXED GLAZING
7'-0"
8'-0"
8'-6"
7'-0"
SPACE HEATER
30'-0" STEEL JOIST
48" DIA INSULATED CISTERN
FUEL TANK
FOUNDATION
4-2x10" FIR BEAM ON WOOD PILES @ 7'-6" o.c.
1/2" CHIPBOARD SKIRTING EXTENDED TO 6" ABOVE GRADE
FLOOR CONST.
SHEET LINO OR ALTERNATE 3 COATS COLOURED URETHANE
5/8" PLYWOOD SUBFLOOR, 1/2" PLYWOOD DECK
VAPOUR BARRIER, #2 SPRUCE 2x10" @ 16" o.c.
R-12 INSULATION
1 1/2" KB BOARD ON 1"x4" STRAP

Figure 3.7

PASS HOUSE E2 - 1 Storey (Analysis)

(Sheet 3)

CHECKLIST BASED ON KENNEDY-SMITH REPORT DESIGN SUGGESTIONS

HOUSE TYPE:	E-2 1-storey
PLAN CONCEPT:	day living area surrounded by heat buffer spaces, bedrooms oriented north with volume of spaces decreasing with distance from heat source, living space volume greater to accommodate high intensity use.
SITTING:	perma-frost type foundation, suitable to unprotected areas with high winds.
CONSTRUCTION SYSTEM:	stud walls with roof beams @ 4'-0" o.c.
HEATING SYSTEM:	oil fired space heater
centralized	yes
children protected from burns	yes
chimney protected	yes
all bedrooms heated	through grilles from heater space
air circulation at perimeter	depends on furniture arrangement
added insulation from storage	at south elevation only.
VENTILATION:	
cross ventilation	yes
clothes drying space	no provision
simple kitchen vent	yes
double glazing	yes
triple glazing	upper living room lites
air lock entry	yes
crawl space	yes
insulation	batt in walls and floor, rigid on roof
USE OF SPACE:	
living area doubles as sleeping area	yes
sleeping area used for day sitting	yes
vestibule with adjacent storage	yes
single entry	yes
seasonally expandable spaces	yes
children's study space	can be accommodated in bedrooms 2 and 3
sheltered play space	no
hobby and work space	no
multiple use furniture	no
built-in furniture	yes
movable storage units	no
water storage	outside

COMMENTS ON PLAN:

No view from living space to outside. Built-in furniture can decrease flexibility of space in this plan as there is high intensity use of living space. Built-in ties up one space for one function.

Little spatial variety, feeling of nowhere one can withdraw to inside house during long winter as there is a 2-storey plan.

Figure 3.8

PASS HOUSE E3 - 2 Storey (Main Floor)

(Sheet 1)

Source: J. Pass, Design of Remote Housing in Northern Manitoba, 1974.

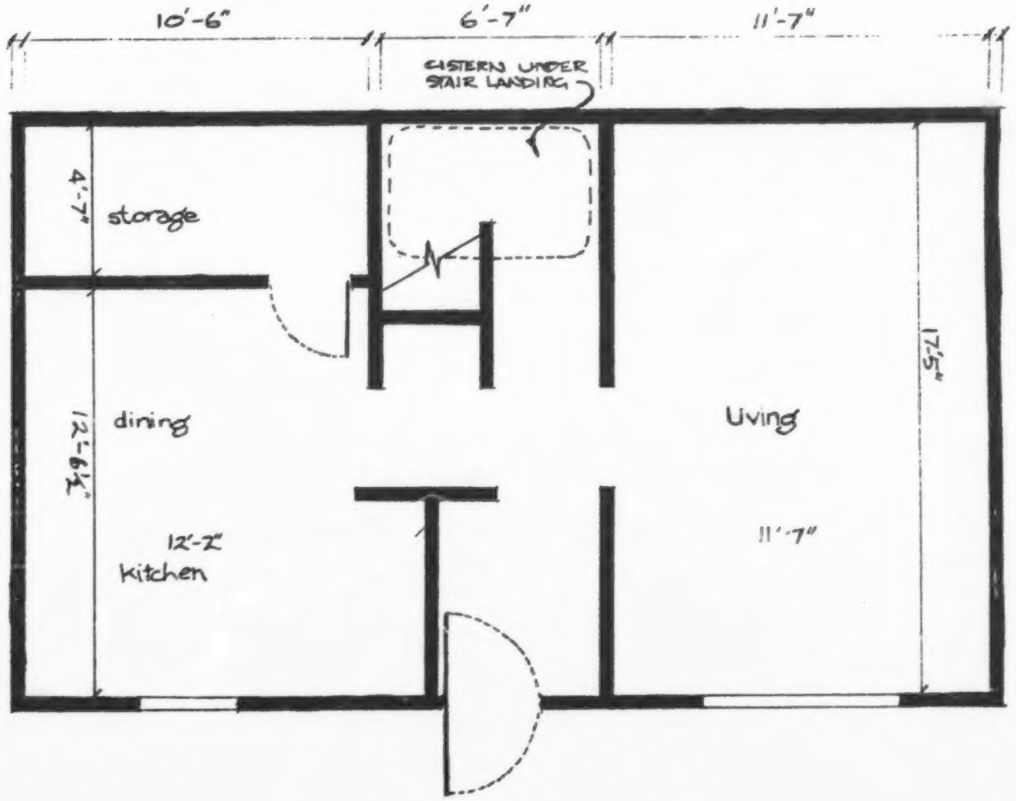

10'-6"
6'-7"
11'-7"
CISTERN UNDER STAIR LANDING
4'-7"
storage
dining
12'-6½"
12'-2"
kitchen
Living
11'-7"
17'-5"

Figure 3.8

PASS HOUSE E3 - 2 Storey (Basement Floor Plan)

(Sheet 2)

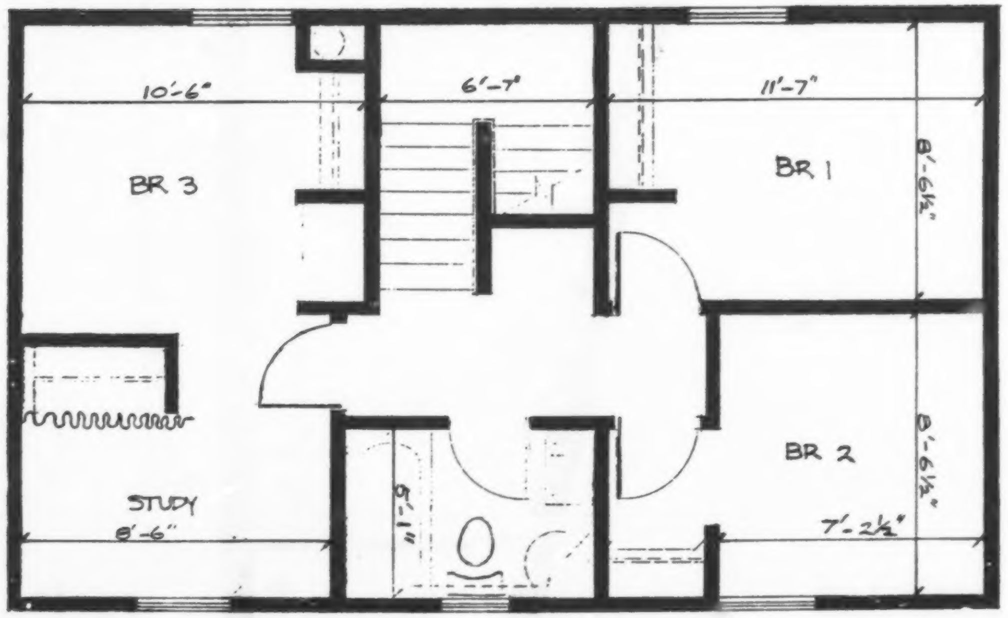

10'-6"
6'-7"
11'-7"
BR 3
BR 1
8'-6½"
BR 2
8'-6½"
STUDY
8'-6"
5'-1"
7'-2½"

Figure 3.8

PASS HOUSE E3 - 2 Storey (Analysis)

(Sheet 3)

CHECKLIST BASED ON KENNEDY-SMITH REPORT DESIGN SUGGESTIONS

HOUSE TYPE:	E-3 2-storey
PLAN CONCEPT:	separated living and dining areas, separete public and private zones.
SITTING:	perma-frost type foundation, north wall with few openings to wind. Suitable to forested areas.
CONSTRUCTION SYSTEM:	stud wall with roof designed for rainwater collection.
HEATING SYSTEM:	standard oil-fired forced air
centralized	partially, on north wall to make positive use of wind effect on forced air ducts.
children protected from burns	yes
chimney protected	yes
all bedrooms heated	yes
air circulation at perimeter	depends on furniture arrangement
storage provides added insulation	yes
VENTILATION:	
cross ventilation	yes
clothes drying space	In storage area off dining area
simple kitchen vent	yes
double glazing	yes
triple glazing	no
air lock entry	yes
insulation	batt insulation walls, floor roof.
USE OF SPACE:	
living area doubles as sleeping area	possible
sleeping area used for day sitting	no, unnecessary in this plan
vestibule with adjacent storage	not directly adjacent
single entry	yes
seasonally expandable spaces	no
children's study space	yes
sheltered play space	no
hobby and work space	partially in storage area
multiple use furniture	no
built-in furniture	not necessary in this plan
movable storage units	one
water storage	inside, under stairs.

COMMENTS ON PLAN:

Higher ratio of circulation to usable spaces compared with other 3 house types. More variety of spaces than single storey types considering year round occupation.

Direct access to living and kitchen spaces from entry and close connections.

Good definition of public from private zones.

Kitchen and bathroom vertically related for future servicing.

3.2 CMHC Housing Design Exercises

3.2.1 Kennedy/Smith Associates Design Study (1967)

In Manitoba, the pioneering study in the field of remote northern housing was Kennedy/Smith Associates' housing study entitled Isolated Communities and Indian Reserves Prairie Provinces. It is a first stage report written in 1967, and was prepared under a grant from the Central Mortgage and Housing Corporation. While outdated in some respects, by today's standards, it is worth noting that this study is one of the first to mention problems of overcrowding, unsanitary conditions, moisture buildup, etc., problems which are still prevalent today in native housing. While not intended to provide a final design solution for Indian housing, the study does provide a conceptual basis upon which to begin. Figures 3.9, 3.10, 3.11, and 3.12 taken from the study reflect such concerns as protected entrances (vestibules), changing interior volumes to coincide with the usage of space to allow for effective heating, plans which can contract into a centralized core for the winter months and expand for the summer, proper winter siting to shield the house from the prevailing wind while taking advantage of solar gain, etc. Other suggestions made int he study include:

> "Develop a simple manually operated ventilator to be installed in a convenient location in the kitchen.
>
> Consider providing fixed windows with a separate vent panel.
>
> Develop a simple means to prevent air circulating below the floor in winter and permit it in summer.
>
> Provide interior storage space where possible, especially in the bedrooms. This space should have racks of wood pegs for hanging clothes, not rods as coat hangers are usually nonexistent or in short supply. Such storage space should be placed to maximize its use as insulation.
>
> Consider the elimination of the second door as it is redundant; provide fire egress some other way." (p. 105)[1]

---

[1] Kennedy/Smith Associates, Housing Study, Isolated Communities and Indian Reserves: Prairie Provinces, First Stage Report, 1967.

Figure 3.9

House Design: Functional Level #2

Source: Kennedy/Smith Assoc. Housing Study.

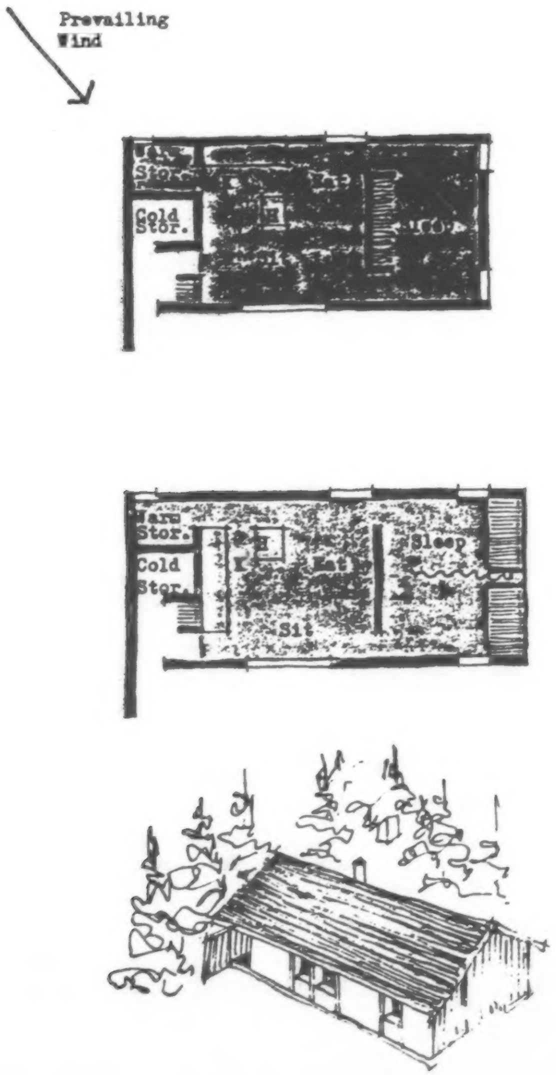
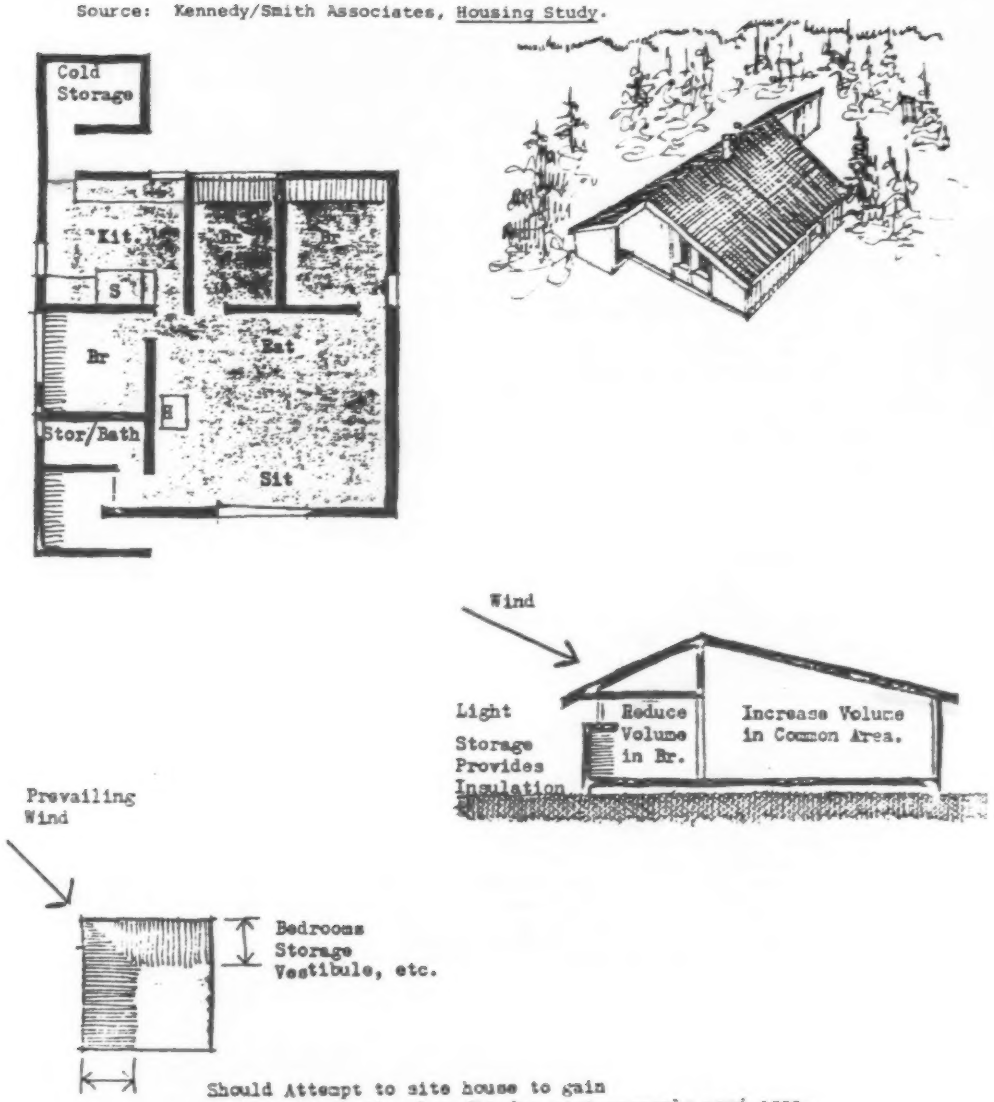

Prevailing
Wind
Stor.
Cold
Stor.
H
Warm
Stor.
Cold
Stor.
H
K
Eat
Sleep
Sit

Figure 3.10

House Design: Responsive to Climatic Conditions

Source: Kennedy/Smith Associates, Housing Study.

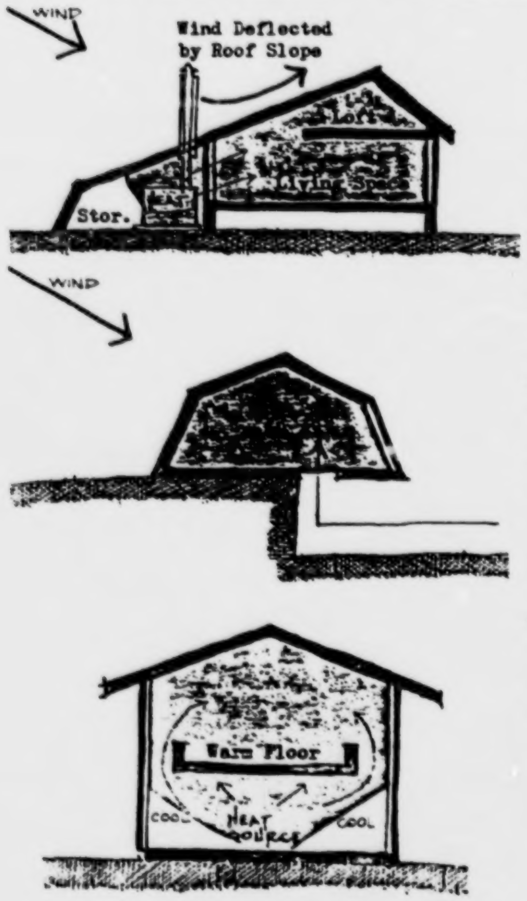

Cold
Storage
Kit.
S
Br
Br
Br
Eat
H
Stor/Bath
Sit
Wind
Light
Storage
Provides
Insulation
Reduce
Volume
in Br.
Increase Volume
in Common Area.
Prevailing
Wind
Bedrooms
Storage
Vestibule, etc.

Should Attempt to site house to gain
maximum insulating benefit for most commonly used area.

Figure 3.11

House Design Concepts

Source: Kannedy/Smith Associates, Housing Study.


WIND
Wind Deflected by Roof Slope
Loft
Living Space
Stor.
WIND
Warm Floor
COOL
HEAT SOURCE
COOL

"Where there is a strong prevailing wind and no sheltering trees, some thought could be given to the feasibility of placing the heat source on the windward side of the house, and slightly below the living level to allow wind pressure to assist in heat distribution."[1]

"By placing the entrance from outside the house below the living level, it is possible to eliminate the cold draft that otherwise sweeps across the floor."[2]

"Using the gravity heat distribution, the floor at the second level is warmer than the floor at the lower level"[3].

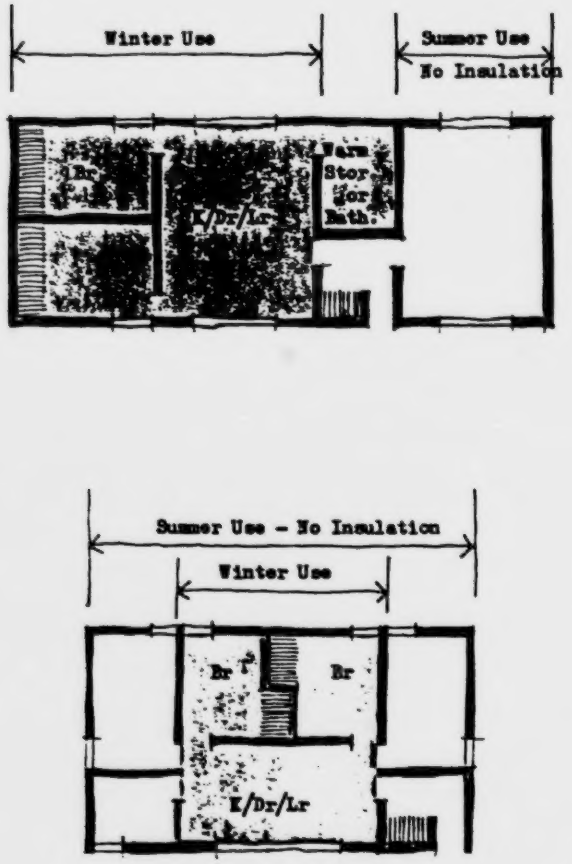
---

[1] Ibid p. 99.
[2] Ibid p. 99.
[3] Ibid p. 99.

Figure 3.12

Houses That Change with the Seasons

Source: Kennedy/Smith Associates, Housing Study.


Winter Use
Summer Use
No Insulation
Br
K/Dr/Lr
Warm Stor. for Bath.
Summer Use - No Insulation
Winter Use
Br
Br
K/Dr/Lr

It is also noted within this study that "in many cases, houses that are produced in the South for southern conditions have little or no relationship to the real needs and conditions of the north. Dwelling types are therefore required which enable the family to more easily make alterations or additions to suit personal needs and family growth and that are more readily adaptable to the local building techniques and materials available".[1]

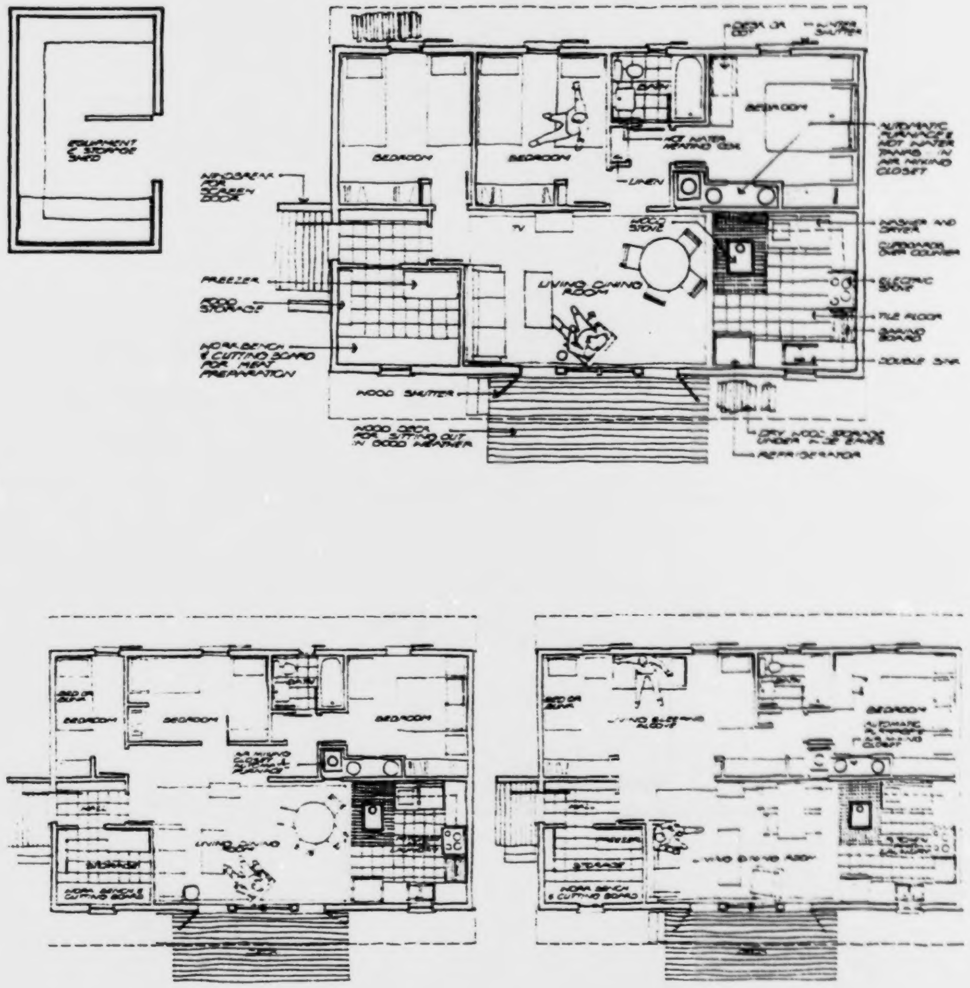
3.2.2 The CMHC Crofter House

Towards the middle of 1984, CMHC unveiled a revamped version of the three bedroom bungalow first introduced to Manitoba Indian communities by MHRC in 1975. This new version attempts to solve the problems which have been plaguing the majority of remote northern houses to date. Flexibility in design of room layouts, moisture control, foundation heaving, and heat distribution are among the issues addressed with these designs. There are four floor plans, two of which have crawlspace or full basement options and have three alternative room layouts each, and two smaller units which have been designed for the disabled, elderly, newly married, or single residents of the community. Figures 3.13 through 3.18 are the floor plans which CMHC is offering. All of the designs assume that complete servicing is available (sewer, water, electricity, etc.), and hence, some of the features they boast would not be available to isolated communities lacking these services. As can be seen, the designs are such that they can be modified as family size changes; i.e. bedrooms no longer required become portions of the living space, after the removal of intervening partitions.

3.2.2.1 The Crofter Heating/Ventilating System

The Crofter designs call for the use of a down flow type electric or oil furnace to be used in conjunction with a wood stove. The furnace is located in its own room (see Figure 3.19) into which combustion air is introduced from outside (if an oil furnace is used). The wood stove is located outside this "furnace room" and it too has a combustion air supply from outside.

Figure 3.13
Crofter House: Model A
(without Basement)


EQUIPMENT & STORAGE SHED
DECK OR DOT
WINTER SHUTTER
BATH
BEDROOM
BEDROOM
BEDROOM
AUTOMATIC FURNACE & HOT WATER TANKS IN AIR MIXING CLOSET
HOT WATER HEATING COIL
WINDBREAK FOR SCREEN DOOR
LINEN
WOOD STOVE
TV
WASHER AND DRYER
CUPBOARDS OVER COUNTER
FREEZER
LIVING DINING ROOM
ELECTRIC STOVE
FOOD STORAGE
TILE FLOOR
BAKING BOARD
WORK BENCH & CUTTING BOARD FOR MEAT PREPARATION
DOUBLE SINK
WOOD SHUTTER
WOOD DECK FOR SITTING OUT IN GOOD WEATHER
DRY WOOD STORAGE UNDER HOUSE EAVES
REFRIGERATOR

---

[1] Ibid, p. 106.

Figure 3.14
Crofter House: Model A
(with Basement)

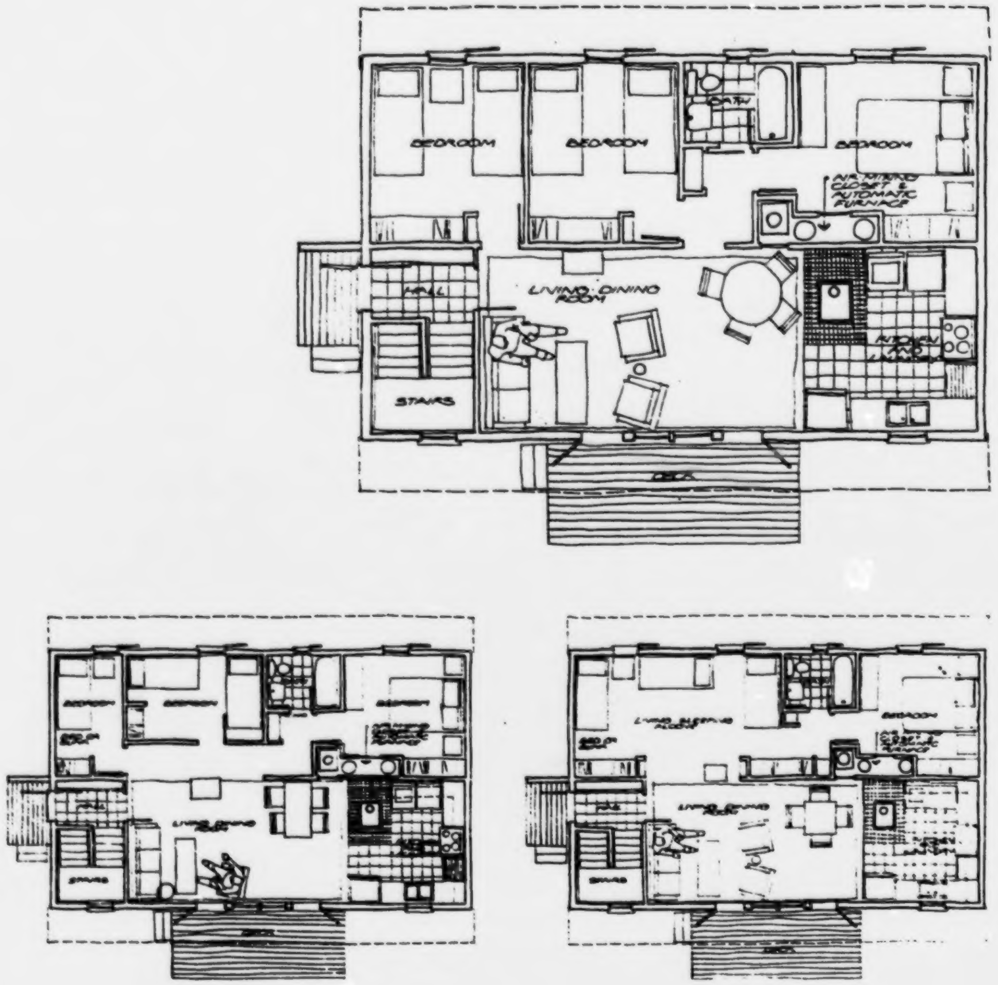

BEDROOM
BEDROOM
BATH
BEDROOM
AIR-HEATED CLOSET & AUTOMATIC FURNACE
HALL
LIVING-DINING ROOM
KITCHEN AND LAUNDRY
STAIRS
DECK

Figure 3.15
Crofter House: Model B
(without Basement)

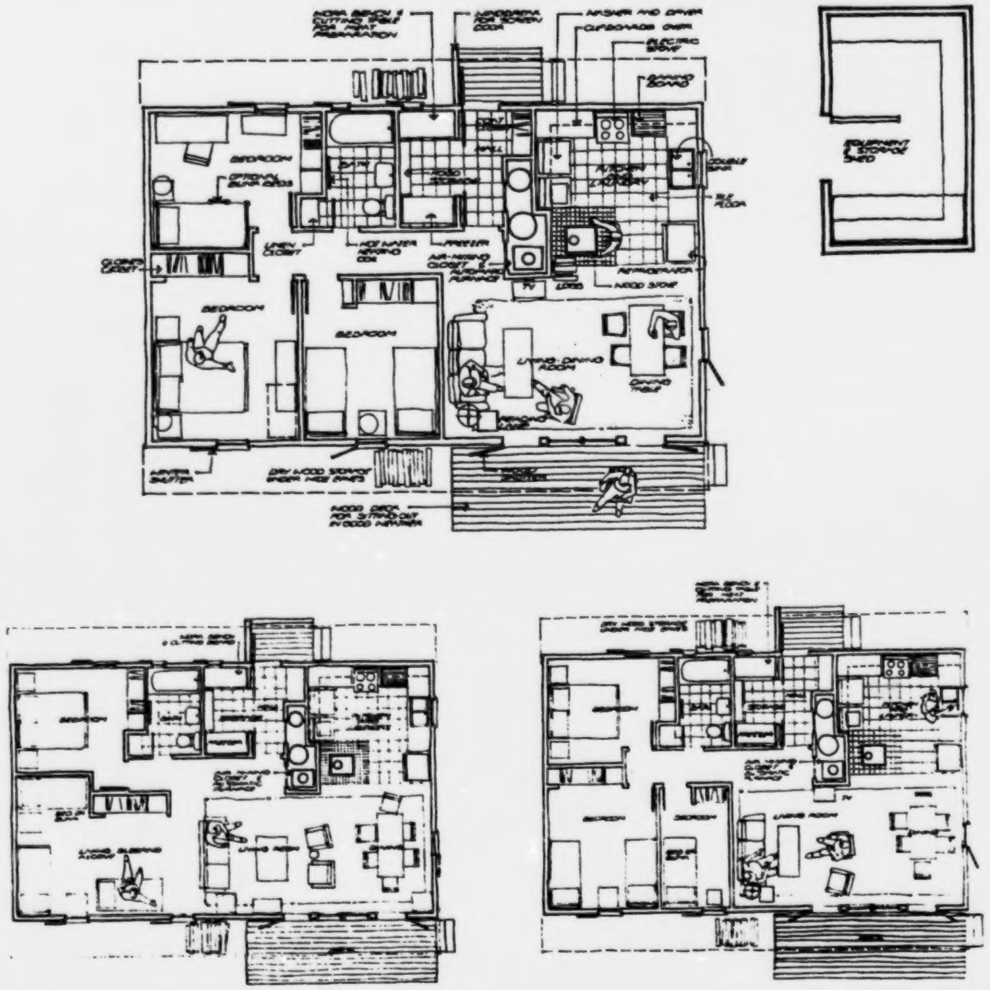

WASHER AND DRYER
CUPBOARDS OVER
ELECTRIC STOVE
BEDROOM
BATH
FOOD STORAGE
KITCHEN AND LAUNDRY
DOUBLE SINK
LINEN CLOSET
HOT WATER HEATING COIL
FREEZER
REFRIGERATOR
WOOD STOVE
CLOTHES CLOSET
BEDROOM
BEDROOM
LIVING-DINING ROOM
DINING TABLE
WINTER SHUTTER
DRY WOOD STORAGE UNDER HOUSE EAVES
EQUIPMENT & STORAGE SHED

Figure 3.16

Crofter House: Model B

(with Basement)

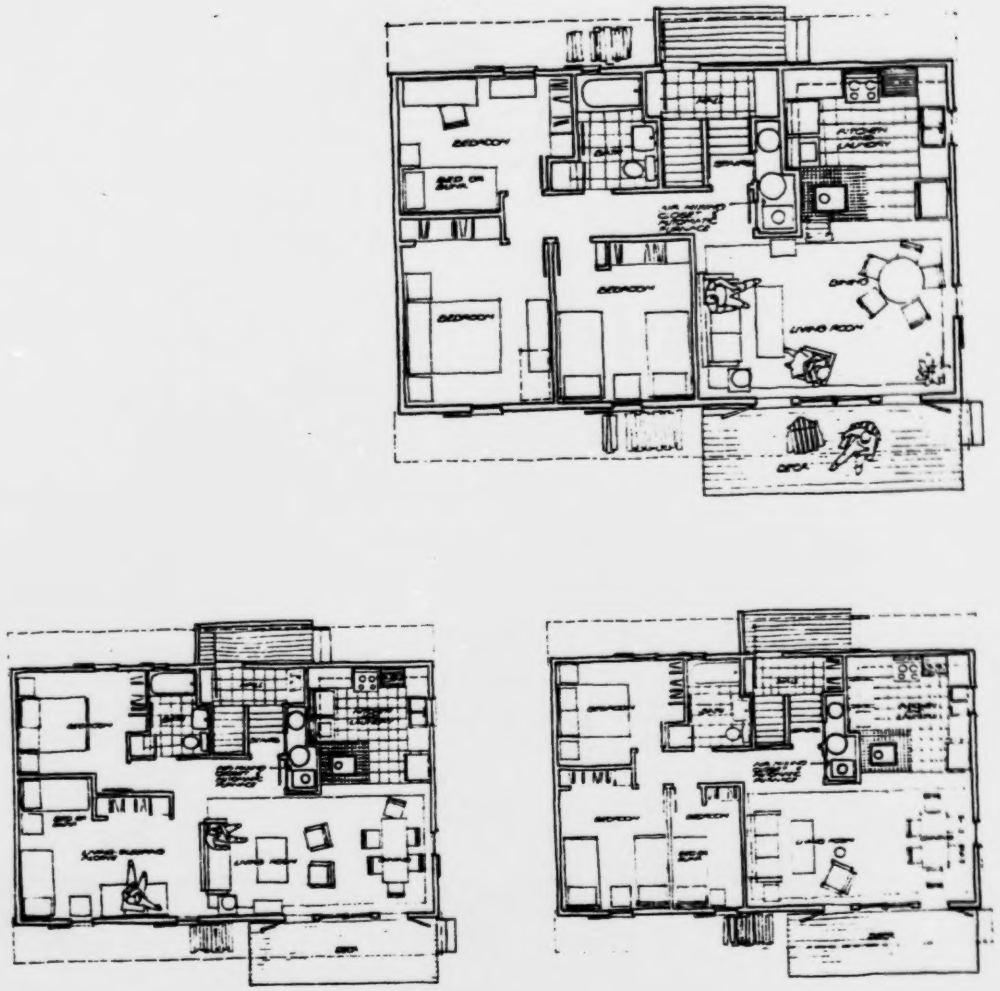

BEDROOM
BED OR SOFA
BEDROOM
BEDROOM
BATH
HALL
STAIRS
KITCHEN AND LAUNDRY
DINING
LIVING ROOM
DECK

Figure 3.17

Crofter House: For the Young,

Elderly or Couples without Children

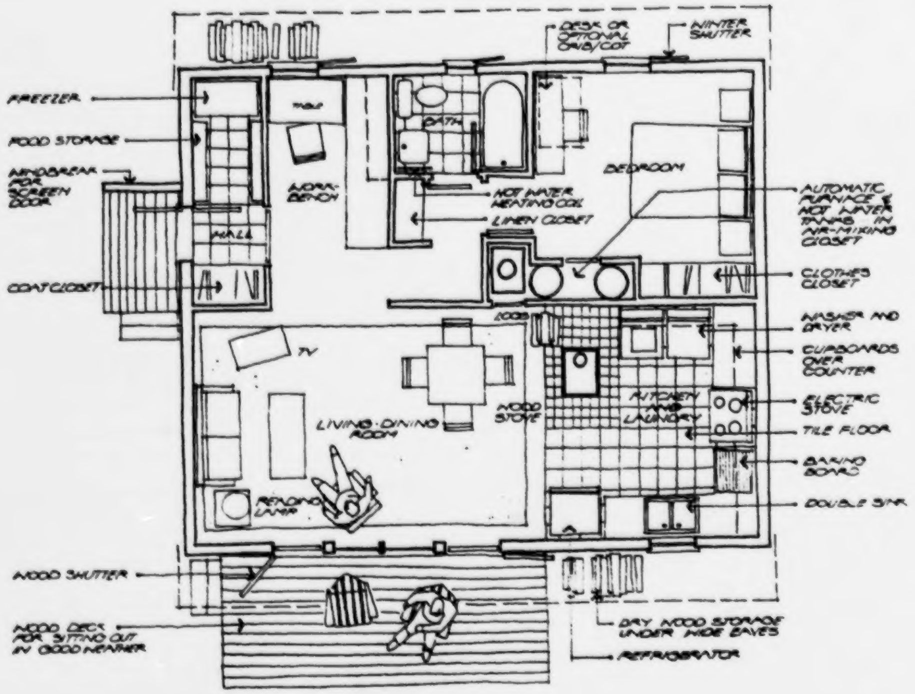

DESK OR OPTIONAL CRIB/COT
WINTER SHUTTER
FREEZER
FOOD STORAGE
WINDBREAK FOR SCREEN DOOR
WORK-BENCH
BATH
HOT WATER HEATING COIL
LINEN CLOSET
BEDROOM
AUTOMATIC FURNACE & HOT WATER TANKS IN AIR-MIXING CLOSET
HALL
COAT CLOSET
CLOTHES CLOSET
LOGS
WASHER AND DRYER
CUPBOARDS OVER COUNTER
TV
LIVING-DINING ROOM
WOOD STOVE
KITCHEN AND LAUNDRY
ELECTRIC STOVE
TILE FLOOR
BAKING BOARD
READING LAMP
DOUBLE SINK
WOOD SHUTTER
WOOD DECK FOR SITTING OUT IN GOOD WEATHER
DRY WOOD STORAGE UNDER WIDE EAVES
REFRIGERATOR

Figure 3.18

Crofter House: For the Disabled

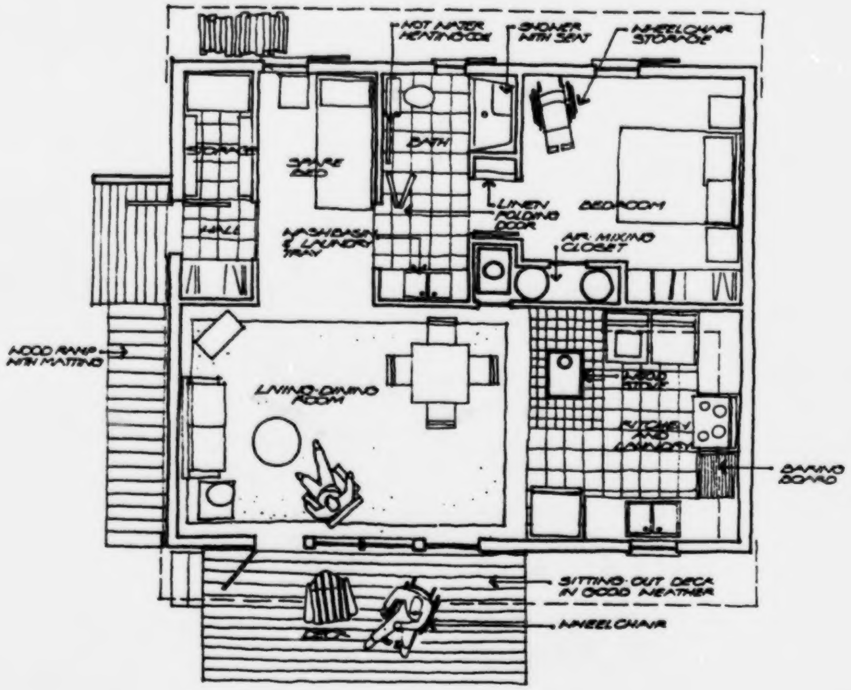
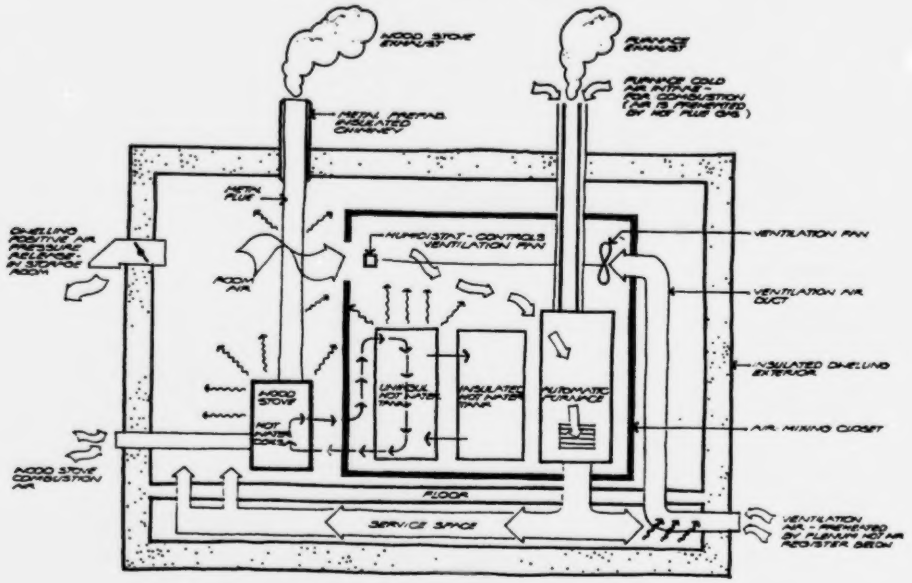

HOT WATER HEATING COIL
SHOWER WITH SEAT
WHEELCHAIR STORAGE
STORAGE
SPARE BED
BATH
HALL
WASHBASIN & LAUNDRY TRAY
LINEN FOLDING DOOR
BEDROOM
AIR MIXING CLOSET
WOOD RAMP WITH MATTING
LIVING-DINING ROOM
WOOD STOVE
KITCHEN AND LAUNDRY
BAKING BOARD
SITTING-OUT DECK IN GOOD WEATHER
WHEELCHAIR
DECK

Figure 3.19

Crofter House: Heating System


WOOD STOVE EXHAUST
FURNACE EXHAUST
FURNACE COLD AIR INTAKE - FOR COMBUSTION (AIR IS PREHEATED BY HOT FLUE GAS)
METAL PREFAB. INSULATED CHIMNEY
METAL FLUE
DWELLING POSITIVE AIR PRESSURE RELEASE - IN STORAGE ROOM
HUMIDISTAT - CONTROLS VENTILATION FAN
ROOM AIR
VENTILATION FAN
VENTILATION AIR DUCT
INSULATED DWELLING EXTERIOR
WOOD STOVE
HOT WATER COIL
UNIFOIL HOT WATER TANK
INSULATED HOT WATER TANK
AUTOMATIC FURNACE
AIR MIXING CLOSET
WOOD STOVE COMBUSTION AIR
FLOOR
SERVICE SPACE
VENTILATION AIR - PREHEATED BY PLENUM HOT AIR REGISTER BELOW

When operating, the heated air from the furnace is sent down and through a central duct located in a service space in the floor which runs the length of the house (See Figure 3.20). From this central duct, the heated air is directed towards the perimeter of the house and released into the rooms. The air in the floor joist spaces is also heated from ducts opening into the space, thus creating a comfortably warm floor. Slots located along the floor at each side of the building allow this heated air to flow into the living space. This system of heat distribution is questionable from a fire safety viewpoint in that a) the ductwork passes within millimeters of exposed polyethylene vapour barrier located below the floor joists, and b) the mothod of heating the joist space itself introduces heated air directly into the wood floor system with its polyethylene barrier. Return air for the furnace enters the furnace room via an opening in the wall of the room, located above the wood stove.

When only the wood stove is used to heat the house, the furnace fan remains operating, distributing the heated air entering the furnace room from the opening above the stove, throughout the rest of the house. Located in the furnace room is also a humidistat, which, when triggered, turns on a fan introducing dry outside air directly into the room for mixing with the return air supply. Another unique feature of this heating system is the use of two connected hot water tanks, one insulated, the other uninsulated. While the wood stove is being used, water is passed through pipes located in the stove, thus allowing the water to be heated. As this heated water sits in the tanks, heat from the uninsulated tank radiates into the surrounding air of the furnace room, mixing with the return air, and then redistributed throughout the house.

3.2.2.2 Foundation System

To help alleviate problems experienced with foundation heaving and to be adaptable to a wide range of site conditions, the Crofter house uses 10 concrete piers which support a series of floor beams or trusses. The piers are formed on site using "sono-tubes" as the formwork. The versions of the Crofter house with full basements use conventional foundations. The use of piers and trusses has the following advantages; as listed in the Crofter house brochure:

"● building heat is not required to give the foundation frost protection; sump and/or pump, weeping tiles and gravel cover are not required.

"● except for general site clearance, tree grubbing and boulder removal is confined to two foundation trenches at the front and back walls.

"● formwork is reduced and piers and footings require only ten per cent of the concrete normally used for a traditional basement.

"● piers can have varying heights to accommodate differences in site steepness and levels of subsoil support.

"● on-site backfill excavation material can be reused regardless of quality.

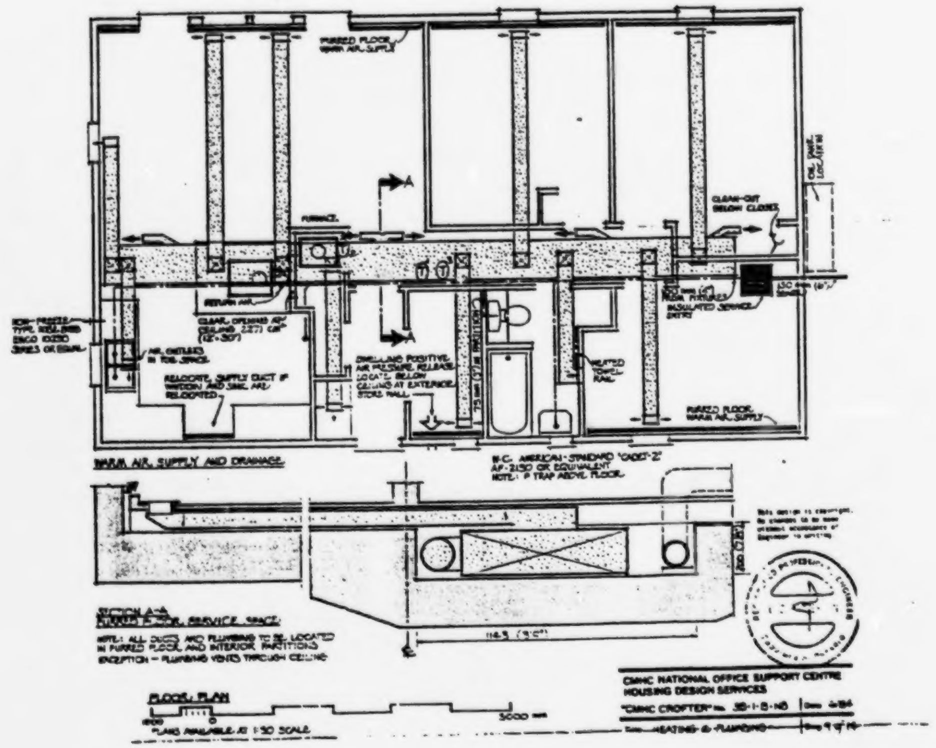
"● radon gas located in the subsoil, which is hazardous to health, cannot enter the living area.

"● potential savings in labour costs and material can be achieved using concrete piers.

"● heating costs are substantially lower compared with those of a home with a basement." (p. 7)[1]

Construction details for the pier foundation system can be seen in Figure 3.21.

Figure 3.20
Crofter House: Heating Ductwork


FURRED FLOOR WARM AIR SUPPLY
FURNACE
A
CLEAN-OUT BELOW CLOSET
RETURN AIR
AIR OUTLETS IN TOE SPACE
RELOCATE SUPPLY DUCT IF WINDOW AND SINK ARE RELOCATED
DWELLING POSITIVE AIR PRESSURE RELEASE LOCATE BELOW CEILING AT EXTERIOR STORE WALL
HEATED TOWEL RAIL
INSULATED SERVICE ENTRY
FURRED FLOOR WARM AIR SUPPLY
WARM AIR SUPPLY AND DRAINAGE
W.C. AMERICAN-STANDARD "CADET-2" AF-2130 OR EQUIVALENT
NOTE: P TRAP ABOVE FLOOR
SECTION A-A
FURRED FLOOR SERVICE SPACE
NOTE: ALL DUCTS AND PLUMBING TO BE LOCATED IN FURRED FLOOR AND INTERIOR PARTITIONS
EXCEPTION — PLUMBING VENTS THROUGH CEILING
1143 (3'9")
FLOOR PLAN
0
5000 mm
PLANS AVAILABLE AT 1:50 SCALE
CMHC NATIONAL OFFICE SUPPORT CENTRE
HOUSING DESIGN SERVICES
"CMHC CROFTER" No. 30-1-B-N6
4-84
HEATING & PLUMBING

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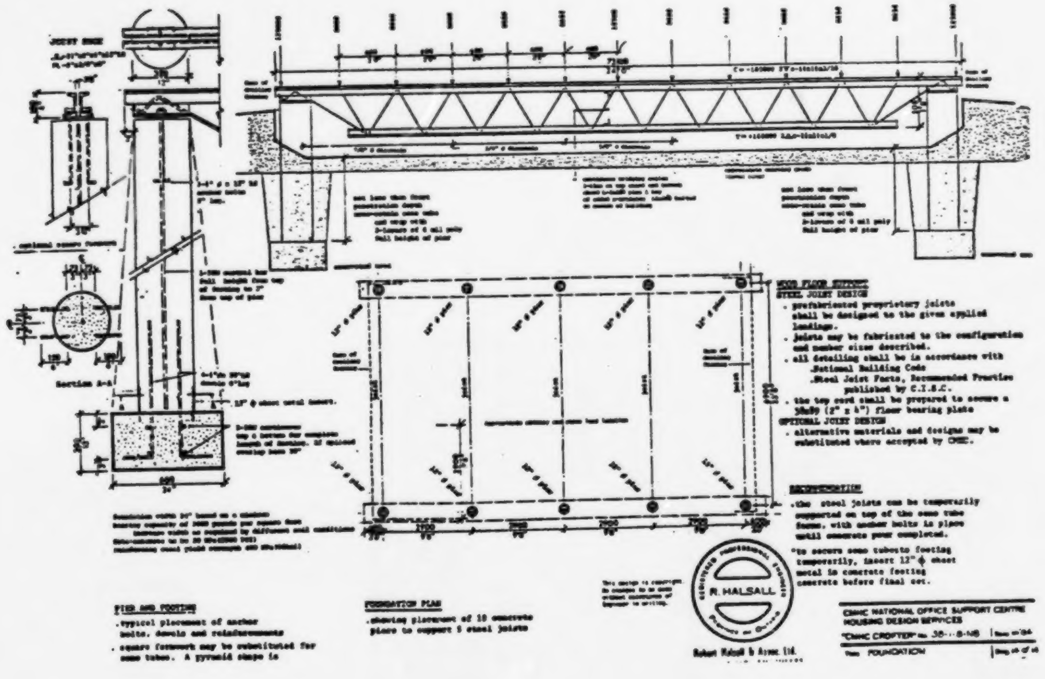
[1] Introducing the CMHC Crofter House (Draft), Canada Mortgage and Housing Corporation, 1984.

Figure 3.21

Crofter House: Foundation Details


Section A-A
STEEL JOIST DESIGN
. prefabricated proprietary joists shall be designed to the given applied loadings.
. joists may be fabricated to the configuration and member sizes described.
. all detailing shall be in accordance with
.National Building Code
.Steel Joist Facts, Recommended Practice published by C.I.S.C.
. the top cord shall be prepared to secure a 38x89 (2" x 4") floor bearing plate
OPTIONAL JOIST DESIGN
. alternative materials and designs may be substituted where accepted by CMHC.
.the steel joists can be temporarily supported on top of the sono tube forms, with anchor bolts in place until concrete pour completed.
*to secure sono tubosto footing temporarily, insert 12" ϕ sheet metal in concrete footing concrete before final set.
PIER AND FOOTING
.typical placement of anchor bolts, dowels and reinforcements
. square formwork may be substituted for sono tubes. A pyramid shape is
FOUNDATION PLAN
.showing placement of 10 concrete piers to support 5 steel joists
R. HALSALL
Robert Halsall & Assoc. Ltd.
CMHC NATIONAL OFFICE SUPPORT CENTRE
HOUSING DESIGN SERVICES
"CMHC CROFTER"
FOUNDATION

3.3 Department of Indian Affairs and Northern Development (DIAND) House Designs

3.3.1 General Architectural Information on DIAND's I.D. and R.D. House Designs

During the early to mid seventies, when the Department of Indian and Northern Affairs (DIAND) became actively involved with the design and delivery of northern housing to the Indian communities, several brochures were produced to enable potential homeowners to select the design which best suits their family's needs. Two of these brochures included House Designs for the Northern Remote and Isolated Areas (Vol. 4), and New Patterns (Vol. 1). Both publications provide designs for suburban and remote sites. House Designs attempts to address the issue concerning poor quality of construction leading to a shorter than acceptable life-span for houses constructed to date. In order to "ensure adequate useful life commensurate with the amount of money spent on it (the house)" (p. 4)[1], the planning and design phase of the process was to be overseen by competent and qualified personnel. Attention was paid to specifications and detailing of the house and its components in order to meet functional and asthetic requirements in as simple and inexpensive a form as is possible for the expected price range of the completed structure. Towards this end, the design process considered such topics as geographical location, climate, occupant lifestyle, cultural aspirations, family size and income, and finally, the type of tenure, be it rental or home ownership.

3.3.1.1 Plans, Elevations and Sections

For the purpose of this review, the Design Team has chosen five house designs from the two aforementioned publications for analysis. From House Designs are found Figure 3.22, a 290 sq. ft. one bedroom bungalow (I.D.1) Figure 3.23, a 560 sq. ft. three-bedroom bungalow (I.D.3), and Figure 3.24, a 460, sq. ft. three bedroom bungalow (I.D.7), while from New Patterns are found Figure 3.25, an 864 sq. ft. two bedroom version bungalow (R.D.6) and Figure 3.26 an 864 sq. ft. three bedroom of the same bungalow (R.D.12).

---

[1] House Designs for the Northern Remote and Isolated Areas (Vol. 4), Draft, Indian and Northern Affairs Canada, August, 1978.

Figure 3.22

House Designs I.D.1

One bedroom Bungalow

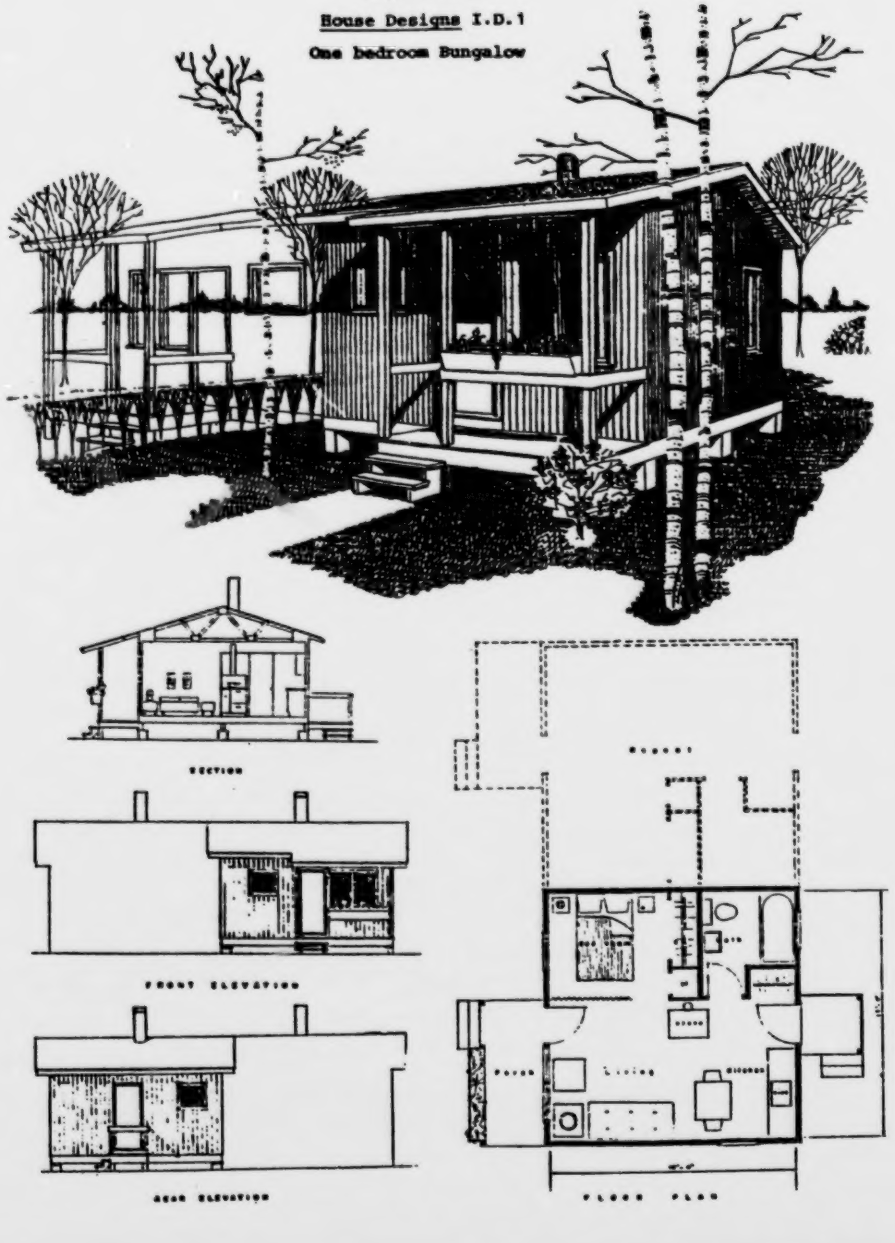

SECTION
FRONT ELEVATION
REAR ELEVATION
Porch
Living
Kitchen
FLOOR PLAN

Figure 3.23

House Designs I.D.3

Three bedroom Bungalow

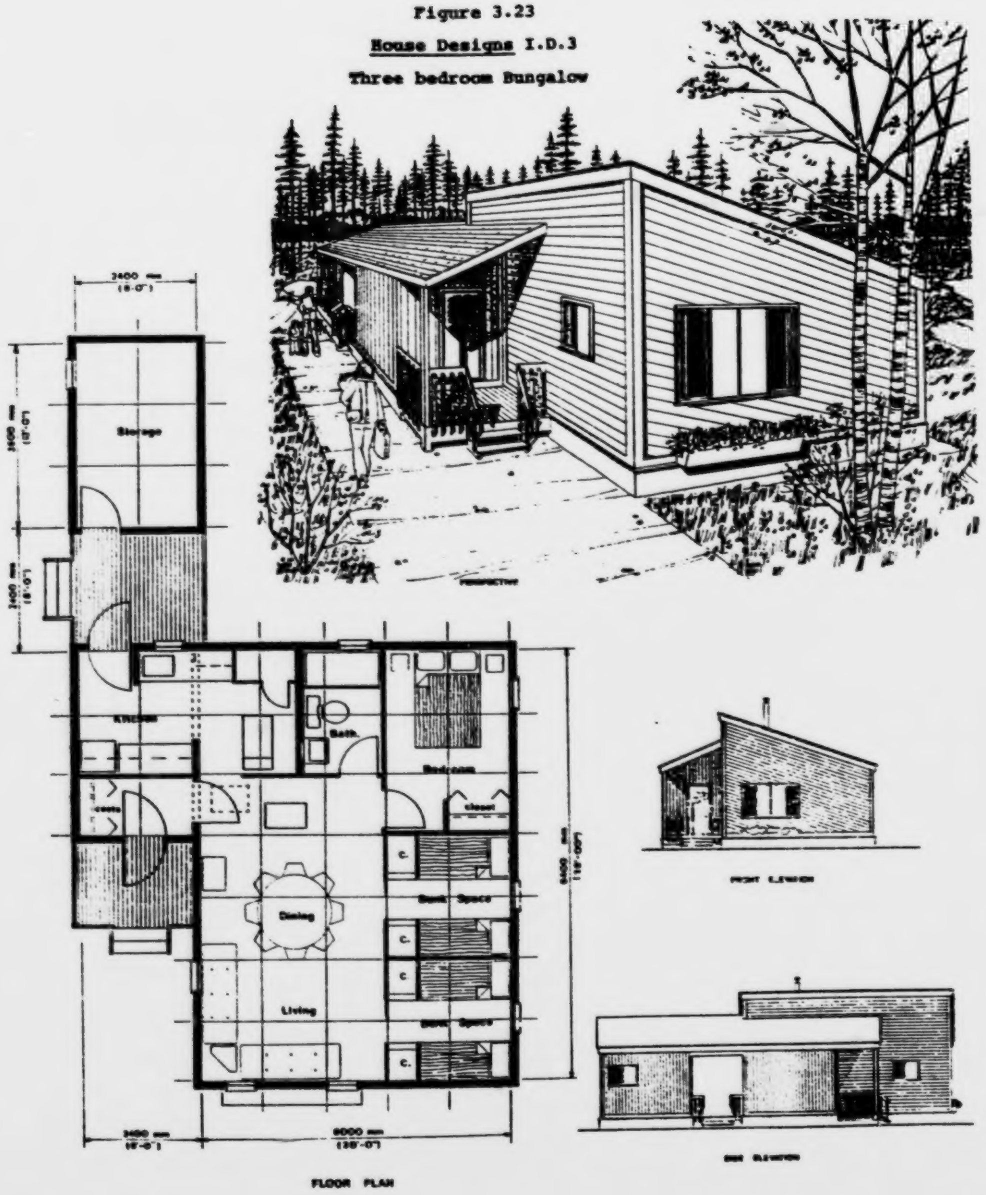

PERSPECTIVE
2400 mm (8'-0")
3600 mm (12'-0")
2400 mm (8'-0")
Storage
Kitchen
Bath
Bedroom
closet
coats
Dining
Bunk Space
C.
Living
2400 mm (8'-0")
FLOOR PLAN
FRONT ELEVATION
SIDE ELEVATION

Figure 3.24

House Designs I.D.7

Three bedroom Bungalow

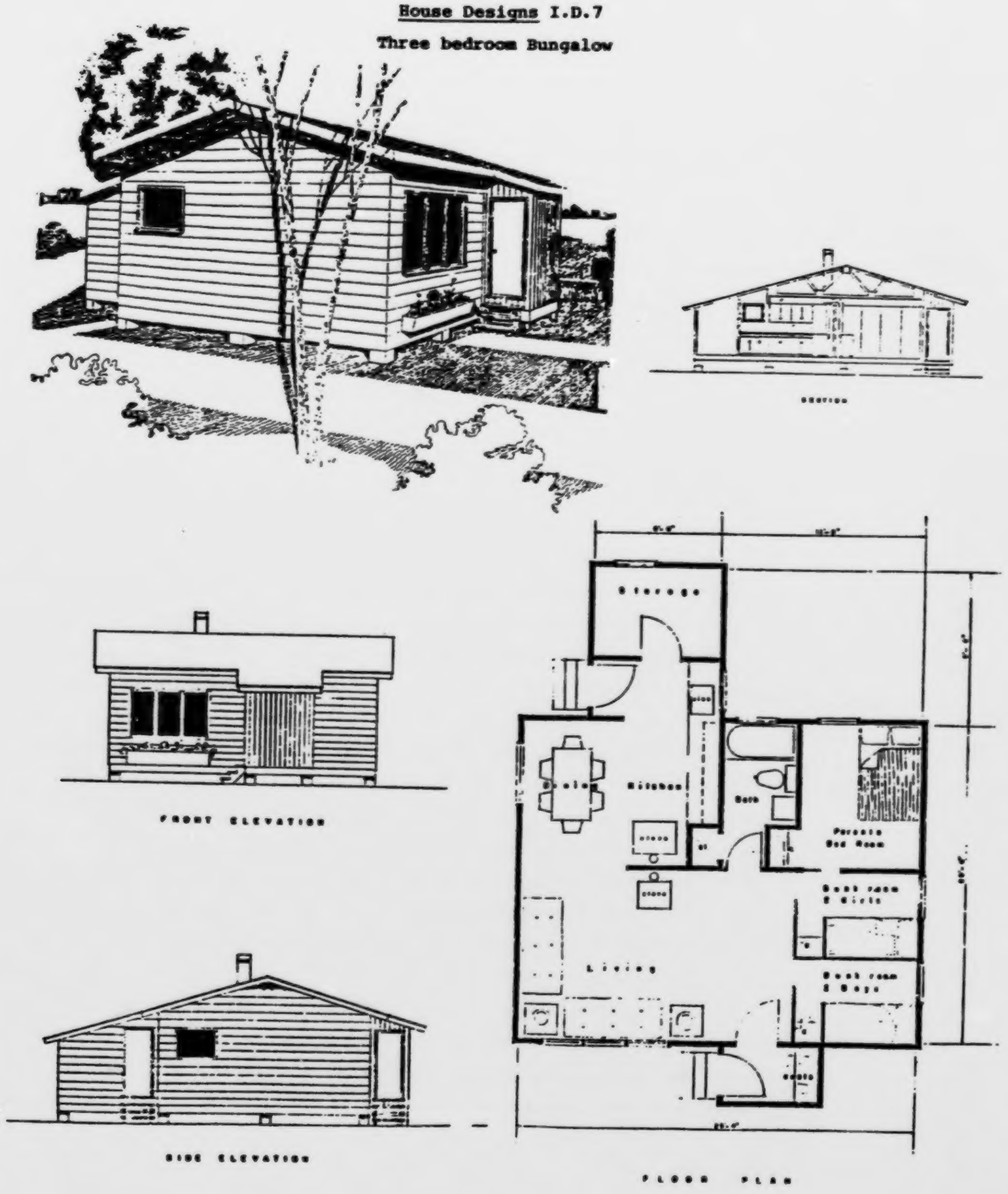

SECTION
FRONT ELEVATION
SIDE ELEVATION
Storage
Dining
Kitchen
Bath
Parents Bed Room
Bed room 2 Girls
Living
Bed room 2 Boys
FLOOR PLAN

Figure 3.25

New Patterns (R.D.6)

Two bedroom Bungalow

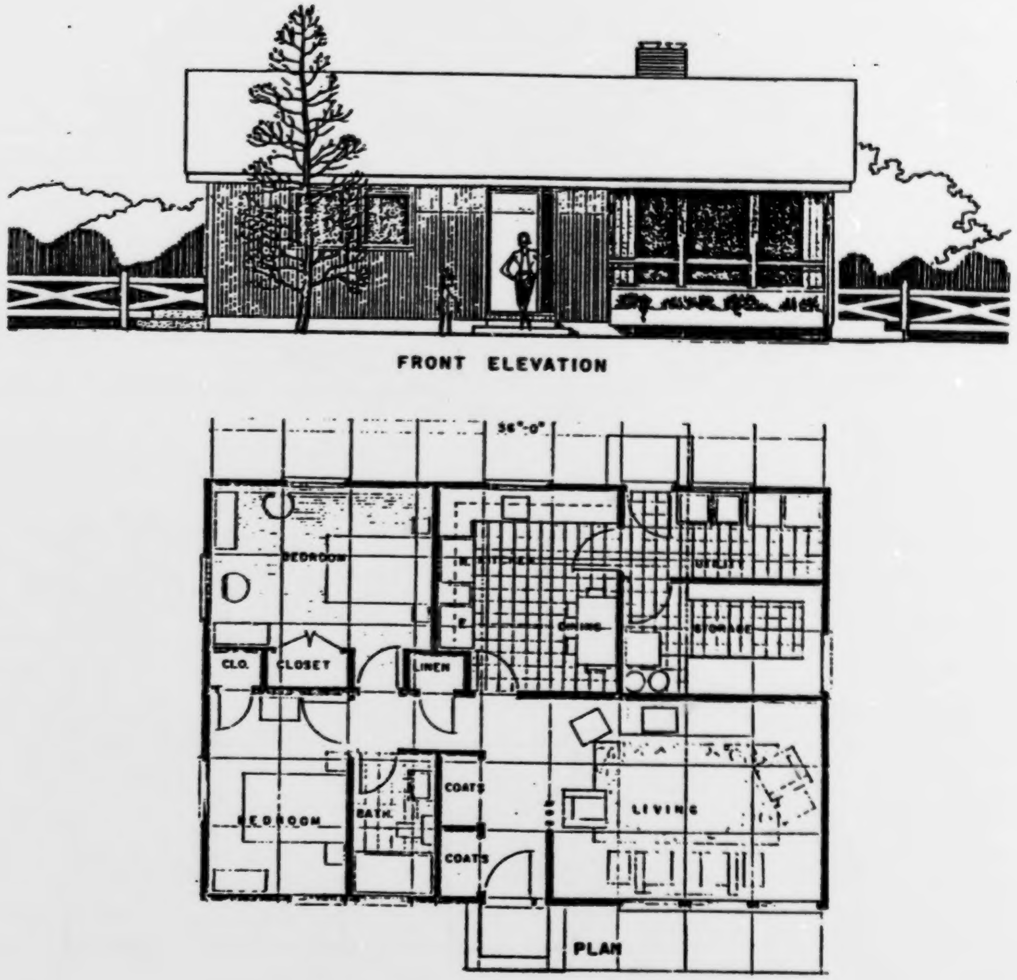
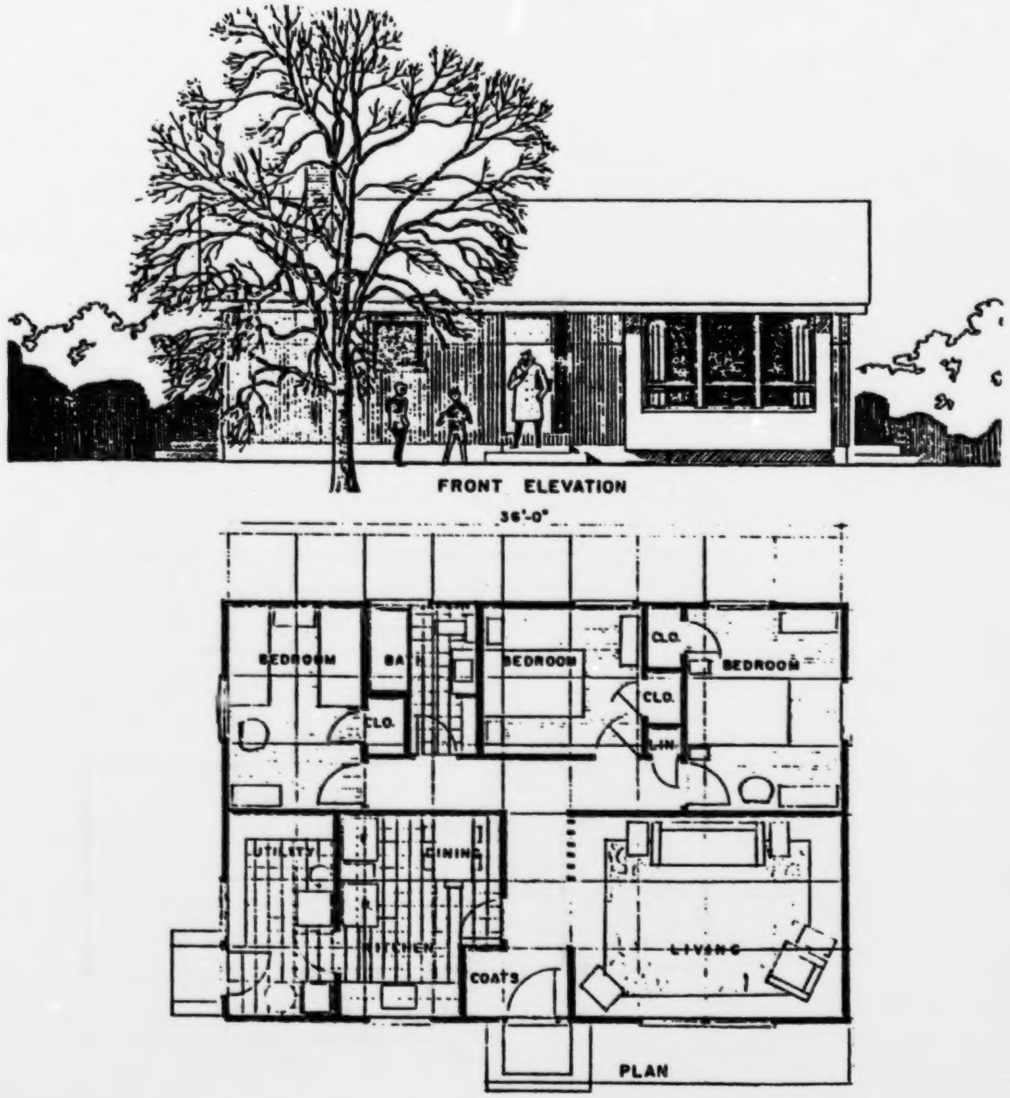

FRONT ELEVATION
38'-0"
BEDROOM
KITCHEN
UTILITY
DINING
STORAGE
CLO.
CLOSET
LINEN
COATS
BEDROOM
BATH
LIVING
COATS
PLAN

Figure 3.26

New Patterns (R.D.12)

Three bedroom Bungalow



All of the house plans given in the two brochures are of the bungalow type, with some having the option of a full basement instead of a crawlspace.

3.3.1.2 Functional Considerations

Being meant for singles, young married couples without children, and the elderly, house plan I.D.1 is a compact design allowing for its one bedroom to become part of the daytime living area of the house by means of a folding door opening along its width. Without this feature, the 17' x 17' house could become unbearable to live in for extended periods of time due to its small size. The floor plan is divided between living/dining/kitchen area one on side, and bedroom/bathroom on the other. Another version of the plan is extended 3' to make a 17' x 20' house, thus allowing for easier movement inside when it is furnished. The relationship of the bathroom to the exit from the house leaves much to be desired as when utilizing the "honey bucket" system, one must pass by the kitchen with the bucket in order to empty it outdoors. Very little storage space is available in this plan, with only the closets located in the bedroom and by the rear entrance performing this function.

The I.D.3 house design (Figure 3.23) is a 28' x 20' bungalow incorporating in a shed roof. Its layout is similar to MHRC's R3 design, but has two smaller bedrooms used for bunk beds (each room sleeping 4, for a total possible sleeping accommodation of 10 in the house) and the kitchen being extended outwards from the rectangular plan to form a wall of the optional storage area. A separate storage/maintenance building has been provided, it being accessible from the kitchen by a covered walkway formed by extending the roof line. There has been very little storage space allowed for within the house, in that only the master bedroom and entrance vestible include closets. A feeling of spaciousness is obtained in this narrow plan due to the lack of obstruction between the living/dining and kitchen areas. The 60-64 sq. ft. allocated for the dining area is inadequate for the number of people the house was designed to sleep, and passage from the entrance to the living area may be tight depending on the location of the table in this dining room. The bathroom is poorly located in that one must carry the "honey bucket" through the dining area before reaching the exit from the house.

The design for I.D.7 (Figure 3.24) is similar to I.D.3 except in that it is smaller in size (24' x 20') and the bedroom and two bunk rooms run along the width of the house and not the length as in the previous plan. Once again, storage space within the house is at a premium, and one must travel either through the living room, or through the dining/kitchen area to get from the bathroom to an exit from the house. Being smaller than I.D.3, the potential for overcrowding is much greater in this design as this house too is designed to sleep 10 people. It would be impossible to find an area in which to be by oneself or to escape from noisy areas for quiet study, rest, etc. With this plan, as in I.D.3, there has been no attempt made to separate private from public spaces, mainly due to the limitations imposed by such a small floor area.

The two plans from DIAND's New Patterns, R.D.6 and R.D.12, (Figures 3.25 and 3.26 respectively) present a more standardized version of a bungalow. Being over 800 square feet each, the floor plan is similar to those produced by MHRC (see Section 3.2).

R.D.6 (Figure 3.25) is a two bedroom design, incorporating two-thirds of the total floor area as segregated living (190 ft.^{2}), kitchen/dining (144 sq. ft.) and utility/storage (144 sq. ft.), space and the bathroom (26 sq. ft.) and two bedrooms (96 sq. ft. and 117 sq. ft.) comprising the other one-third. The plan would appear more spacious if some of the interior partitions were removed, especially between the kitchen/dining and living rooms. House R.D.12 (Figure 3.26) evenly splits the plan lengthwise between the bedroom and the living areas. It too suffers from unnecessary confinement which could be easily alleviated with the removal of partitions between living and kitchen areas.

Both plans show good separation between the public living areas and the private bedroom areas; as the bedrooms are not directly accessible from the living room. This is achieved with the use of a hallway leding from the living/entrance area to the bedrooms. The bathrooms are inadequately located in that one must travel as far as 20 feet through designated living space before reaching an exit from the house. The placement of a utility/storage space adjacent to the kitchen and accessible from the exterior should provide adequate interior storage space along with the closets in the bedroom and by the front entrance.

3.3.1.3 Building System

Although no specific building system has been proposed for any of the designs, the DIAND brochure House Designs suggests that their solutions are adaptable to stickbuilt log construction, ready-to-move plants (houses built in two sections for shipment) and premanufactured panels for erection on site. Despite which system is chosen, it is recommended that the following minimum requirements for construction be met:

> "a) Availability and price of materials where it is best to stay with materials readily available at an economical price;
>
> b) Quality of labour available for the job in that untrained labour will require much more guidance. Electrical/heating/plumbing should be undertaken only by qualified personnel; and
>
> c) A competent design which will ensure a means of quality control."[1]

3.3.1.4 Mechanical/Ventilation Systems

No specific heating system has been proposed by any of the designs either. Wood stoves can be adapted to all of the I.D. designs, with adequate heat distribution to be possible if doors to the bedrooms are left open. The problem with the smaller plans will be in overheating during the winter months, especially if the houses are constructed to energy efficient standards. Both of the R.D. houses have been designed with centralized forced air systems as the heat supply. No provision has been made for a wood stove, and if one is used, the segregated nature of the plan will lead to difficulty in heat distribution throughout the structure.

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[1] Ibid, p. 8.

3.3.2 Mr. B. Chill (DIAND) House Designs

Mr. B. Chill of DIAND Headquarters, Ottawa has become an authority in the field of northern housing design and detailing. The majority of his work centres on housing designed to meet the stringent demands of true arctic conditions, and because of this, his designs have become quite elaborate when detailing the type of construction, and heating ventilating systems, which require preciseness and added cost to construction which are beyond the capabilities, (and even needs), of the communities being encompassed within this study. It is for this reason that a detailed analysis of his house designs has not been attempted in this review. As an example of his floor layouts, a 1,000 sq. ft. three bedroom bungalow with a full basement (Figure 3.27 (sheet 1 and 2)) has been included. The basement is located at ground level, with one entering the living area of the house from below. The plan has allowed for the separation of the bedrooms from the noisier activity areas of the house, as well as provides quick access from the bathroom to the exit located a storey below. The design utilizes a prefabricated panel construction technique, and is heated by a forced air oil heating system, with the furnace located in the basement. Because of the airtight nature of construction, elaborate ventilation systems have been introduced to allow sufficient combustion air into the structure to allow for a healthy living environment.

Figure 3.27

Bob Chill's Staff House Design
Upper Floor Plan
(Sheet 1)

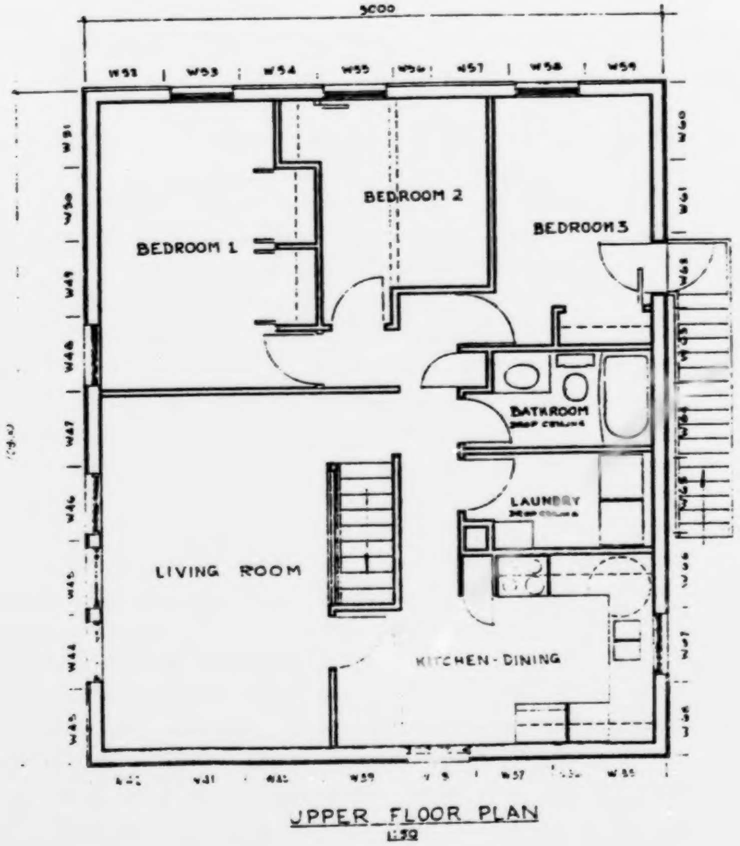
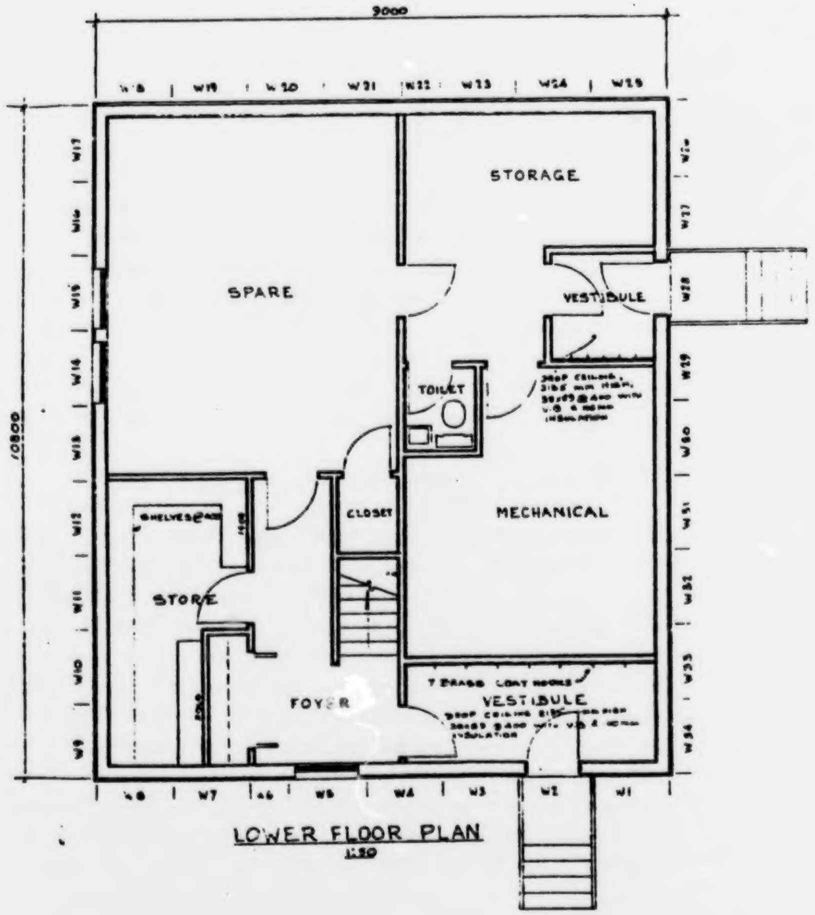

5000
W53
W54
W55
W56
W57
W58
W59
W51
W50
W49
W48
W47
W46
W45
W44
W43
W60
W61
W39
BEDROOM 1
BEDROOM 2
BEDROOM 3
BATHROOM
DROP CEILING
LAUNDRY
DROP CEILING
LIVING ROOM
KITCHEN - DINING
UPPER FLOOR PLAN
1:50

Figure 3.27

Bob Chill's Staff House Design
Lower Floor Plan
(Sheet 2)



3.4 Quebec/Naskapi Housing Designs

3.4.1 General Architectural Information

Towards the end of 1976, the Shelter Systems Group from the School of Architecture, McGill University submitted their final report entitled Appropriate Building Energy Systems for Quebec Indian Communities which concerns the analysis of four dwelling units which they had designed for northern Indian communities. This endeavour was funded under the Quebec Indian Housing Project, which was interested to encourage the development of experimental houses which respond to environmental and socio-cultural need of Quebec Indians. They were environmental in that they involve the use of passive and active solar heating systems, as well as being constructed of locally produced building materials, and socio-cultural in that the project involved Indians at all levels of planning and work. Some of the overall project objectives are summarized in the study as follows:

> "1) to build prototype housing units for Quebec Indian communities and to ensure that the built units satisfy Indian aspirations.
>
> 2) to promote, through the introduction of 'environmentally appropriate' building and energy systems and labour intensive methods, a greater awareness of the prospects for local/indigenous control of housing.
>
> 3) to advance the exploitation of 'local' building materials and thereby reduce the cost of house construction.
>
> 4) to enhance traditional Indian sensitivity to the impact of man-made structures on the natural environment.
>
> 5) to use the prototype building operation as a vehicle for training unskilled and semi-skilled Indian builders". (p. 9)[1]

A more recent project, is the one Shelter Corporation performed for the Naskapi Indians under the Northeastern Quebec Agreement during the period 1981-83. Three houses were designed and constructed in 1981 to act as demonstration models, each employing different construction techniques in order to determine which details perform the best at reasonable cost to build. In 1982, new houses were constructed employing the "best" ideas generated from the experience gained from the 1981 houses.

---

[1] Shelter Systems Group, Appropriate Building and Energy Systems for Quebec Indian Communities, December, 1976.

3.4.2 Floor Plans, Elevations, Sections

Only three of the four plans developed by the Shelter Systems group will be considered as the fourth structure is also meant to act as a Band Office and hence is beyond the scope of this review. The designs which will be considered are; Côte Nord House (Fig. 3.28 (Sheets 1, 2 and 3)), Pte Blue House (Fig. 3.29 (Sheets 1 and 2)) and Mistassini House (Fig. 3.30). Figure 3.31 (Sheets 1 and 2) pertain to Shelter Corporation houses which were refined from the 1981 and 1982 demonstration houses.

3.4.3 Functional Considerations

3.4.3.1 The Côte Nord House

Côte Nord house is a three bedroom design of undertermined dimension. The plan is divided lengthwise with the bedrooms and bath located towards the north side, and the living, kitchen and dining areas located towards the south. The entire south wall of the building acts as a solar collector (see Fig. 3.28 (Sheet 1)). In appearance as well as layout, this house (and even more noticeable with the Pte Blue and Mistassini houses), is closely related to the houses from the arctic region which will be examined in section 3.5. Both styles utilize expansive south glazing to maximize solar gain, as well as to orient the daytime activity areas towards the warmer section of the house. Although little distinction between public and private space has been allowed with locating two of the bedrooms directly off of the living room, there is the potential to expand the daytime activity area by incorporating moveable panels or folding doors which would open the bedrooms into the rest of the living area. This would aid greatly towards utilizing the maximum amount of space available in the house on a daily basis. Criticisms that can be made of the existing layout include the lack of adequate [illegible] storage space, and the location of the both away from the exit door making the use of the "honey bucket" system inconvenient (but, to be fair, the original intention for waste disposal in this design did not intend the use of the "honey bucket" system, see section 3.4.6.).

3.4.3.2 The Pte-Blue House

The Pte-Blue house was also designed to allow the use of solar gain to heat the living space. As described in the report, the "Rooms were disposed to allow maximum southern exposure and minimum exposure on the north, east and west sides. The two-storey shell, with a split-level entrance, affords southern exposure for all habitable rooms of the house and permits more privacy between living and sleeping areas than does the Côte Nord prototype. . . . the two-storey form allows for all the rooms to be directly adjacent to the south facing collector wall, and suits application of the 'Trombe Wall' heating system."[1] Although interior storage facilities are limited, an unheated area has been provided opposite the entrance to the house. Also opposite to the entrance, and thus easily accessible to it, is the bathroom, located on the lower level of the house along with two of the three bedrooms. A feeling of spaciousness is obtained on the upper living section where the living, dining and kitchen areas are unobstructed from each other by unnecessary partitions.

3.4.3.3 Mistassini House

The remaining Shelter System Group house to be examined is the triangularly shaped Mistassini house (Fig. 3.30). This form for the building allows for the maximum wall area to face south for passive solar heat gain, and the minimum wall area to face north. Although no exact size for the house has been provided, it is known that it was meant to house an extended family, and hence is quite large when compared to the other houses examined in this review. One enters the house from the north side under a sheltered entrance, and through a vestibule where one climbs up or down a set of stairs to reach large, centrally located, living/activity spaces. Directly adjacent to the entrance is located the bathroom, allowing this design to use the "honey bucket" system safely. On the lower level, the central living space is flanked on one side by two bedrooms, and on the other by activity rooms. The upper level is also

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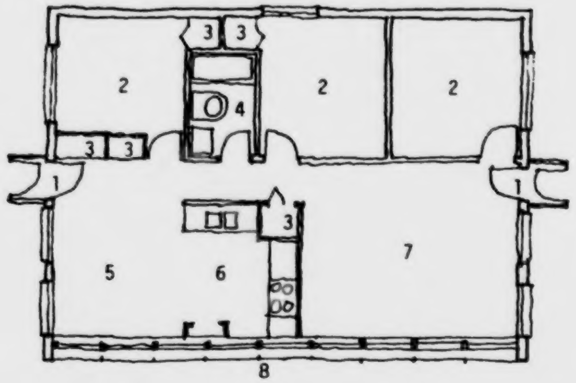
[1] *Ibid*, p. 41.

Figure 3.28

Côte Nord; Main Floor Plan and Storage Level

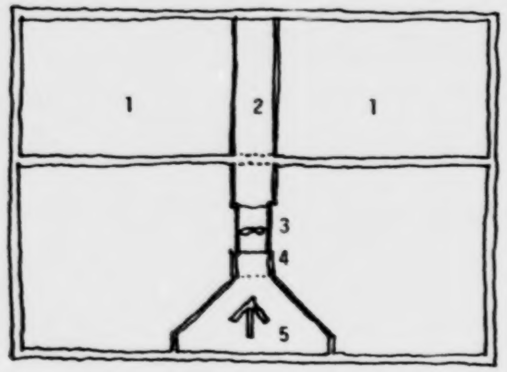
(Sheet 1)

Source: Appropriate Building Energy Systems



Ground Floor Plan

1. entry vestibule
2. bedroom
3. closet
4. bathroom
5. dining
6. kitchen
7. living room
8. solar collector



Plan at Storage Level

1. rocks
2. duct
3. fan
4. filter
5. air flow

Figure 3.28

Côte Nord House; Elevations

(Sheet 2)

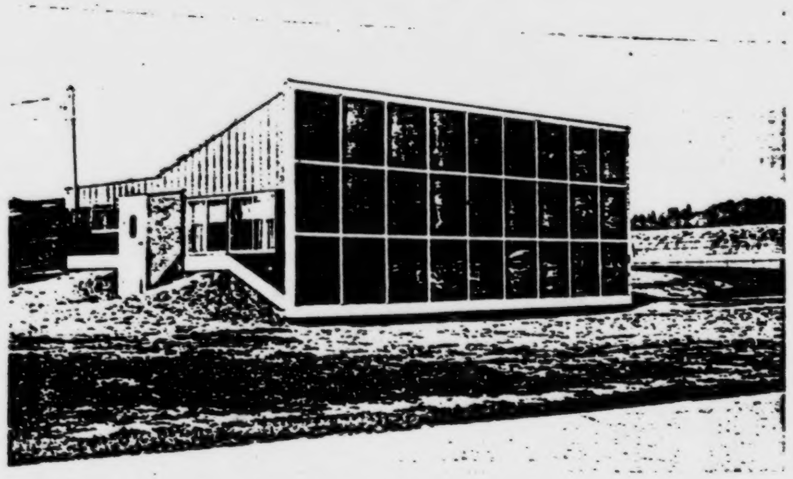


Plate 1 - Front View of Côte Nord House

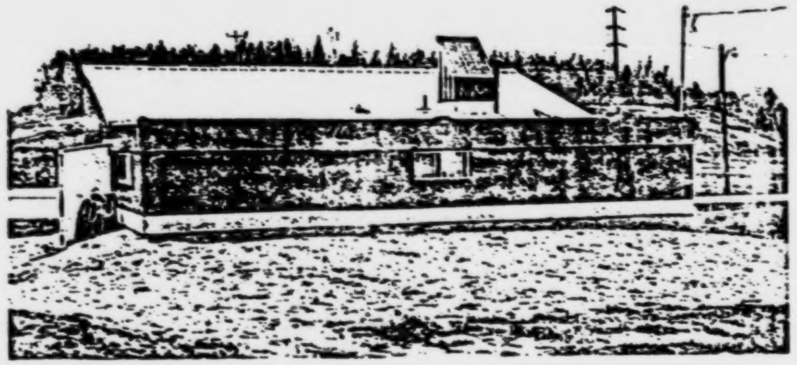


Plate 2 - Rear View of Côte Nord House

Figure 3.28

Côte Nord House; Section

(Sheet 3)

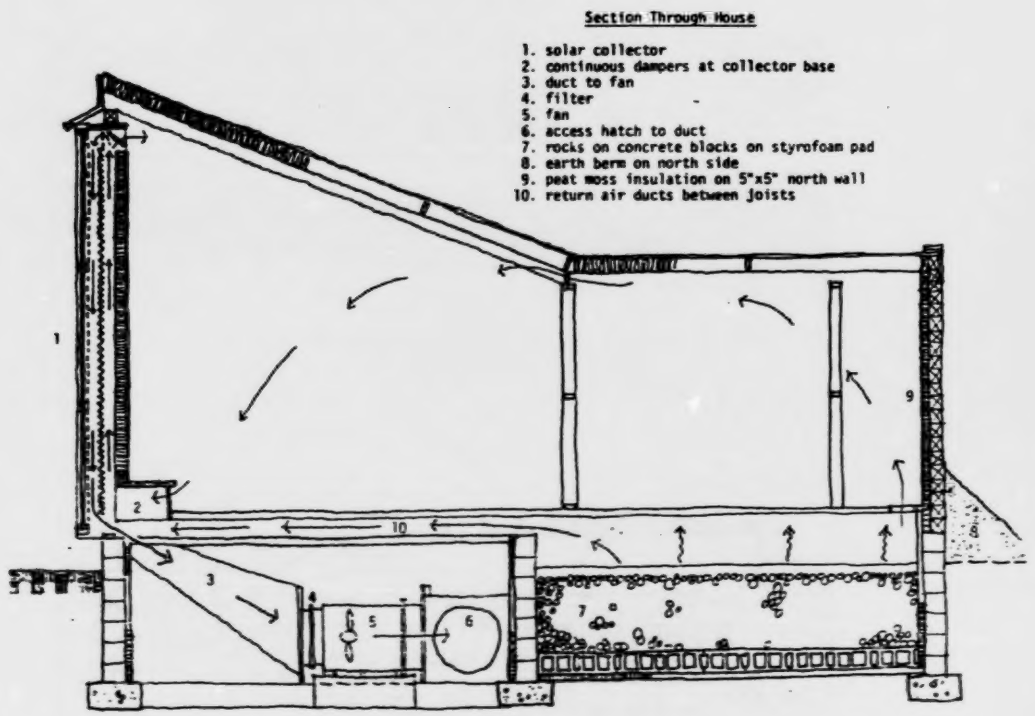

Section Through House
1. solar collector
2. continuous dampers at collector base
3. duct to fan
4. filter
5. fan
6. access hatch to duct
7. rocks on concrete blocks on styrofoam pad
8. earth berm on north side
9. peat moss insulation on 5"x5" north wall
10. return air ducts between joists
1
2
3
4
5
6
7
8
9
10

Figure 3.29

Pte Blue House; Upper and Lower Floor Plans

(Sheet 1)

Source: Appropriate Building Energy Systems

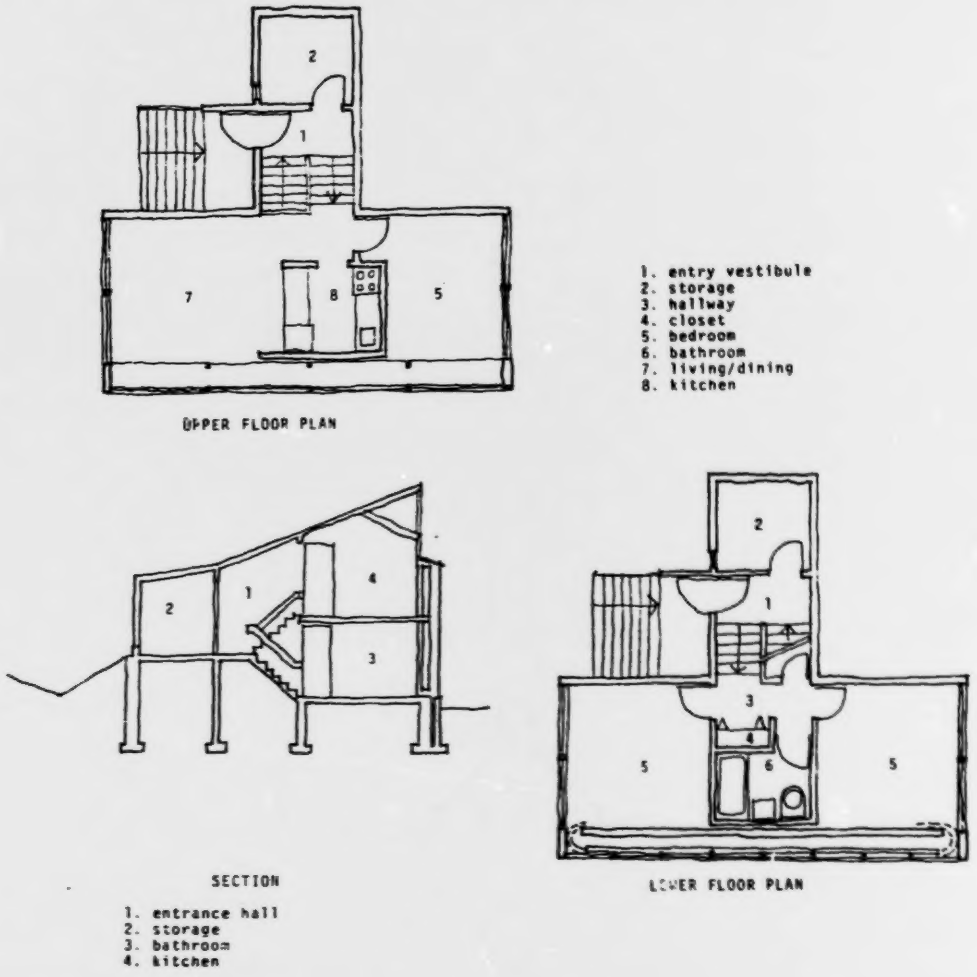
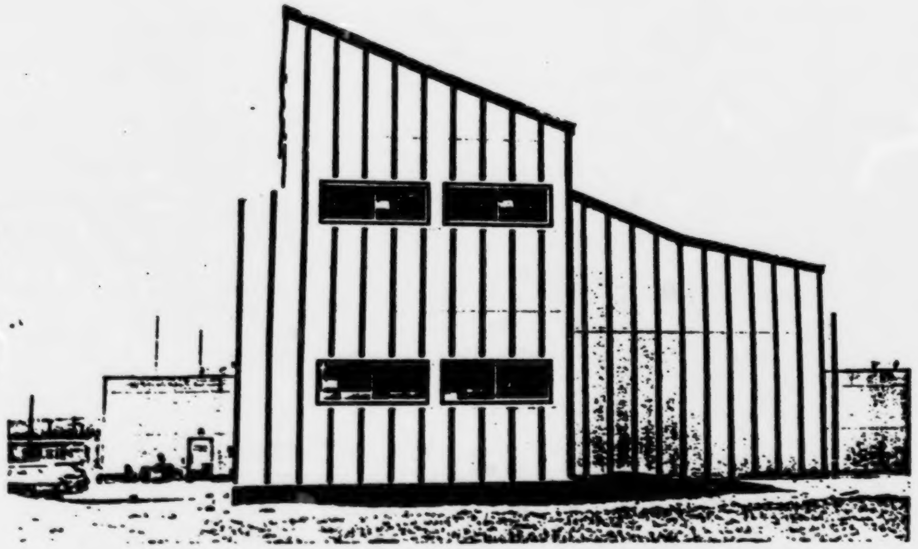

1. entry vestibule
2. storage
3. hallway
4. closet
5. bedroom
6. bathroom
7. living/dining
8. kitchen
UPPER FLOOR PLAN
SECTION
1. entrance hall
2. storage
3. bathroom
4. kitchen
LOWER FLOOR PLAN
1
2
3
4
5
6
7
8

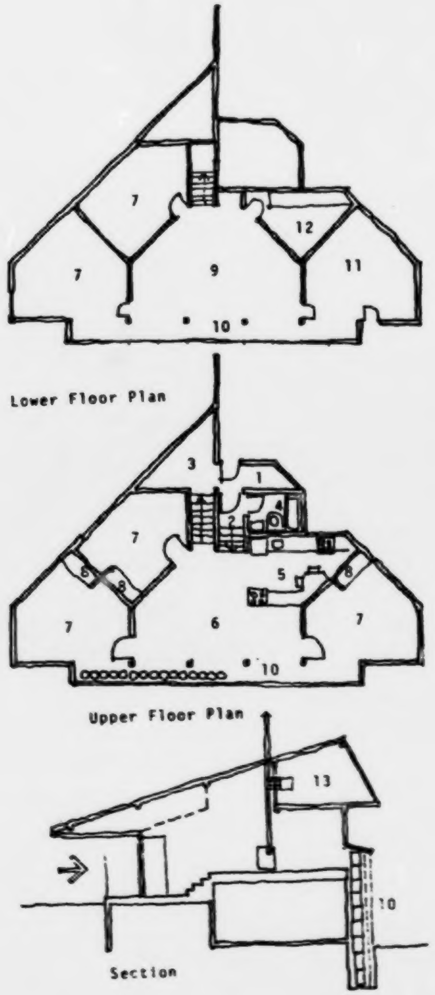
Figure 3.29
Pte-Blue House; Elevation
(Sheet 2)



East Elevation: Pte Bleu House

Figure 3.30
Mistassini House; Upper & Lower Floor Plan, Section

Source: **Appropriate Building Energy Systems**


7
12
11
7
9
10
Lower Floor Plan
3
1
7
8
8
5
8
7
6
7
10
Upper Floor Plan
13
10
Section

1. entry vestibule
2. landing
3. storage
4. bathroom
5. kitchen
6. living
7. bedroom
8. closet
9. living/children
10. solar wall
11. pottery
12. laundry
13. greenhouse

Figure 3.31

Shelter Corporation; Naskapi House

Plan & Elevation Views

(Sheet 1)

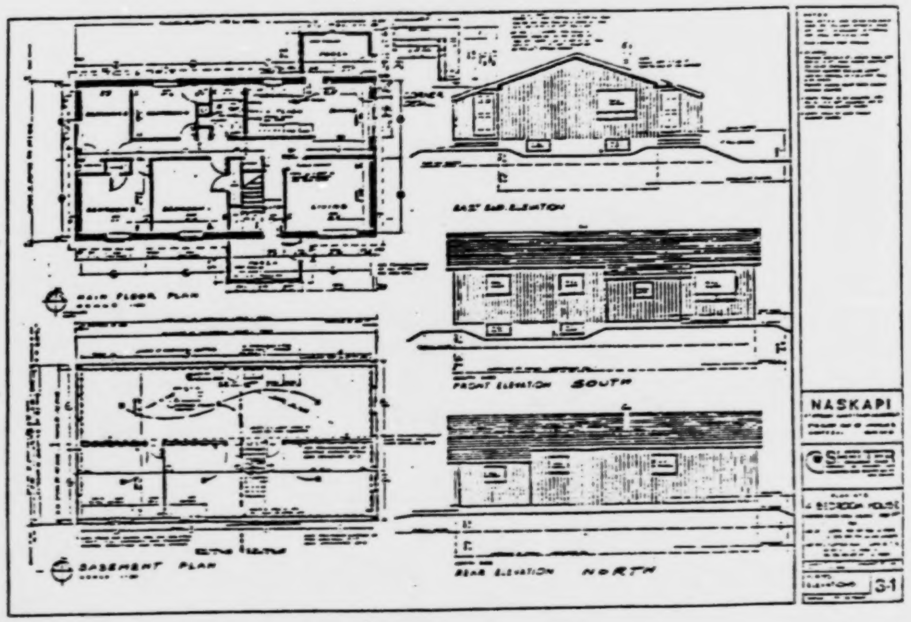
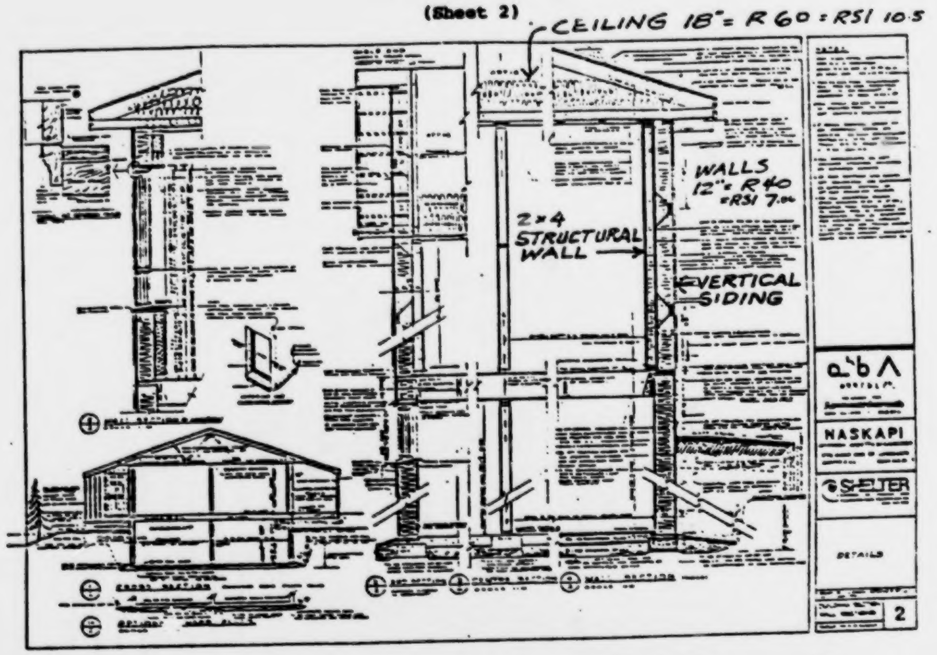

MAIN FLOOR PLAN
BASEMENT PLAN
EAST END ELEVATION
FRONT ELEVATION SOUTH
REAR ELEVATION NORTH
NASKAPI
SHELTER
4 BEDROOM HOUSE
31

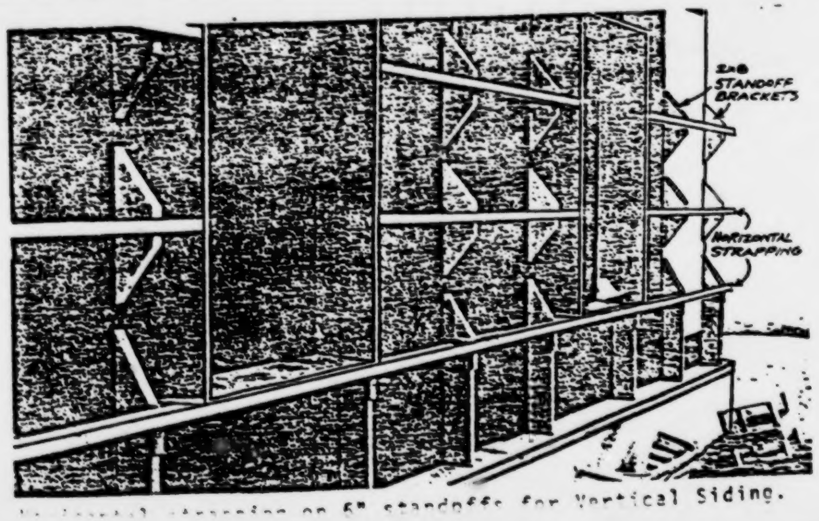
Figure 3.31

Shelter Corporation; Naskapi House

Section and Details

(Sheet 2)


CEILING 18" = R 60 = RSI 10.5
WALLS 12" = R40 = RSI 7.0
2×4 STRUCTURAL WALL
VERTICAL SIDING
NASKAPI
SHELTER
DETAILS
2


2×6 STANDOFF BRACKETS
HORIZONTAL STRAPPING

Horizontal strapping on 6" standoffs for Vertical Siding.

flanked on one side with two bedrooms, as well a bedroom and a kitchen on the opposite side. A loft area above the upper living space is used as a greenhouse, but could easily by converted into another bedroom area for larger families. Despite its large size, a disproportionate small space has been devoted to storage, which would result in families using either one of the bedrooms or activity areas for the purpose of increasing it.

3.4.3.4 Shelter Corporation's Naskapi House

Shelter Corporation's four-bedroom Naskapi house (Figure 3.31) took the more conventional bungalow layout, with the living room, dining room and kitchen at one end of the house, and the bedrooms on the other. The addition of enclosed unheated porches on both sides of the house allows room for storage as well as provides a means of having a vestibule entrance without sacrificing much needed interior floor area. The main exphasis behind this design is not so much the functional layout of the interior spaces, but rather the building envelope itself and trying to obtain a means by which to increase its overall effectiveness.

3.4.4 Social Considerations

In their review of the objectives they set forth within the report, the Shelter System group writes **"experience with Indian work crews, clients, and local populations during the construction, process indicates, that very few Indian families would wish to build their own houses using 'appropriate technology'.** Nor is it likely that many communities would be equipped with sufficiently motivated workman to build using labour-intensive methods, particularly if money to build the houses was in short supply and controlled by the Band itself."[1] They go on to say that "This is not to say that there is not a desire on the part of Indian communities to be more autonomous in relation to the finance and implementation of housing ... (but) it is only possible to obtain this autonomy through a massive public education program - one component which is political and the other technical."[2] Even today it is difficult to find potential householders who are willing to provide their own labour (without remuneration) in constructing their house which would allow the money saved to be spent on higher quality materials

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[1] *Ibid*, p. 80.
[2] *Ibid*, p. 80.

expanding the house size. Most likely, they also feel that before spending money on elaborate solar systems and heat storage capacity, the other, more important needs (adequate storage facilities, efficient heat supply, enough bedrooms, furnishings, etc.) should be provided first. This is an issue which will have to be addressed in the design phase of this project.

3.4.5 The Building System

The Côte-Nord house uses a conventional concrete block foundation wall resting on a continuous concrete footing. The north, east and west walls were constructed of rough cut 5" x 5" spruce (cut and milled locally), while, because of the extensive glazing on the south wall, standard 2" x 4" framing was used. Floor joists were also composed of the rough cut 5" x 5" spruce whereas larger dimensional lumber for the rafters had to be shipped in (due to the small diameter of the trees found at this location). Figure 3.28 shows the typical composition of the walls and roof. The concrete blocks of the foundation are insulated on the exterior with 2" Dow ship-lap "Roof Mate" insulation. The same insulation (3" in thickness) was used on the inside surfaces of the east and west walls. The inside north wall was covered with locally manufactured peat moss insulating panels. The roof is insulated with polystyrene boards - applied to the bottom of the rafters in the bedroom half of the house, and cut and caulked to fit between the rafters in the living space of the house. **No vapour barrier was installed.** Windows are standard wood framed horizontal sliders, with those opening to the living room and dining room being "moderately large to allow for daylighting of these spaces."[1]

The Pte-Blue and Mistassini houses are constructed similarly to Côte Nord, except for the following differences; The Pte-Blue house has walls constructed of 2" x 4" framing throughout, insulated with R15 glass fibre batts and sheathed with 3/8" aspenite on the exterior, and the Mistassini house replaces the concrete block foundations with a pressure treated wood foundation; and has windows in which provide for a 3/16" sheet of plexiglass as a storm window.

---

[1] *Ibid*, p. 28.

For the Naskapi house, which Shelter corporation designed and tested, it was decided to use a 2" x 4" wall @ 16" (on centre or o.c.), upon which triangular brackets are applied to increase the wall thickness to a determined optimum of twelve inches. The triangular brackets allowed vertical siding to be used on the exterior, which could be locally cut and roughsawn. Because the boards do not notch together, they can be easily replaced if damaged. Figure 3.31 provides a detailed section of the walls, roof and basement. To simplify installation of the vapour barrier, it was decided to hang the floor joists from the pressure treated wood foundation walls. This allows the vapour barrier to pass uninterrupted between the floor joists and the wall. This system has proved to work well. Problems with condensation and frost formation where evident where standard floor joist construction was used for the canilevered floor of the two entrance porches.

3.4.6 Heating/Ventilation and Waste Disposal

All three design prototypes built by the Shelter System Group use passive solar collectors and mechanical air distribution systems as well as some means for heat storage. Back up heat was supplied by one of, or combination of, the following, electric baseboards, wood stove (Valley Comfort), or oil stove. (See Figure 3.28 (sheet 3) for the air distribution within the Côte-Nord house). The Pte-Blue house uses a concrete wall which has been painted black to act as its absorbing surface. "Solar radiation is absorbed directly by the concrete wall; this in turn heats a stream of air circulating by natural conviction through parts at the base and top of the collection."[1] The Mistassini House uses water filled drums as its storage medium. Heat absorbed by the mass is released to the living space by radiating from the back wall of the storage system. An insulating curtain incorporated into both Pte- Blue and Mistassini systems is lowered at night to help reduce heat loss to the exterior. Figures 3.32 and 3.33 show cross sections of the Pte Blue and Mastassini systems respectively.

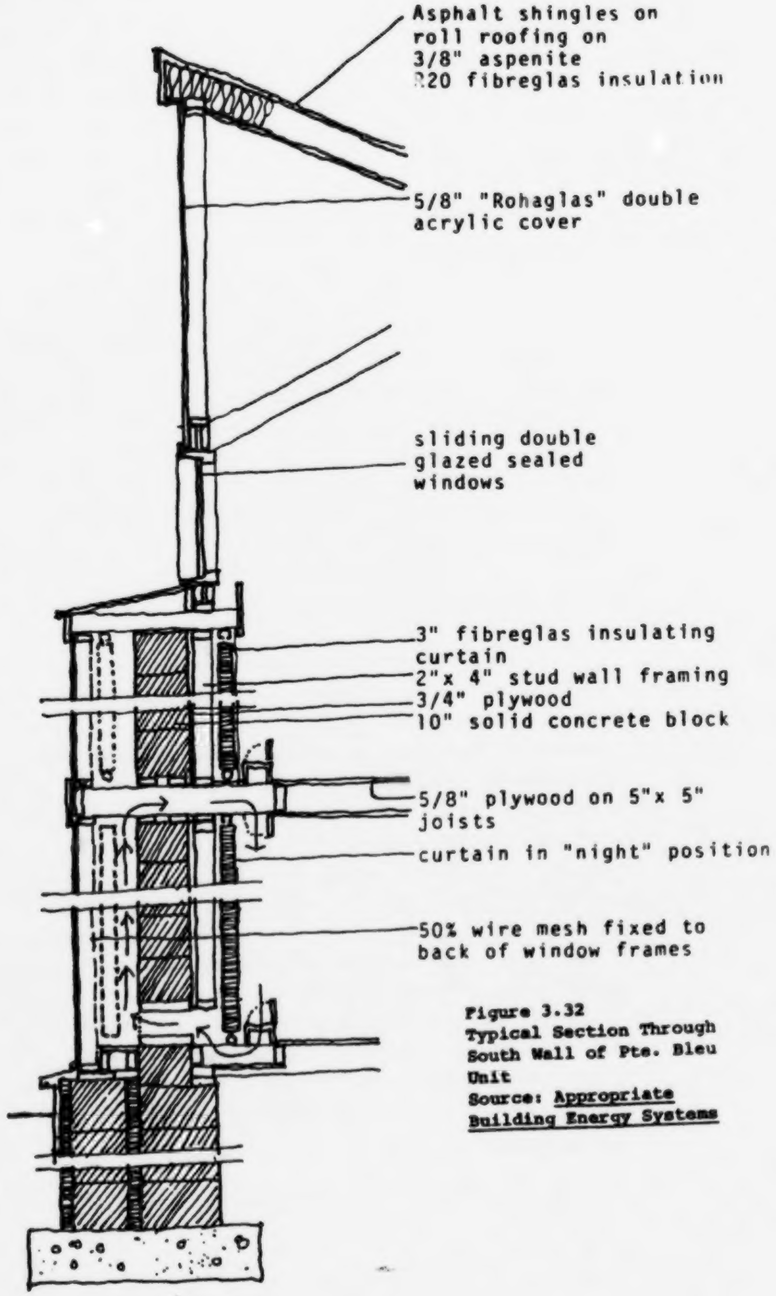
Asphalt shingles on
roll roofing on
3/8" aspenite
R20 fibreglas insulation
5/8" "Rohaglas" double acrylic cover
sliding double glazed sealed windows
3" fibreglas insulating curtain
2"x 4" stud wall framing
3/4" plywood
10" solid concrete block
5/8" plywood on 5"x 5" joists
curtain in "night" position
50% wire mesh fixed to back of window frames

Figure 3.32
Typical Section Through South Wall of Pte. Bleu Unit
Source: Appropriate Building Energy Systems

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[1] Ibid, p. 45.

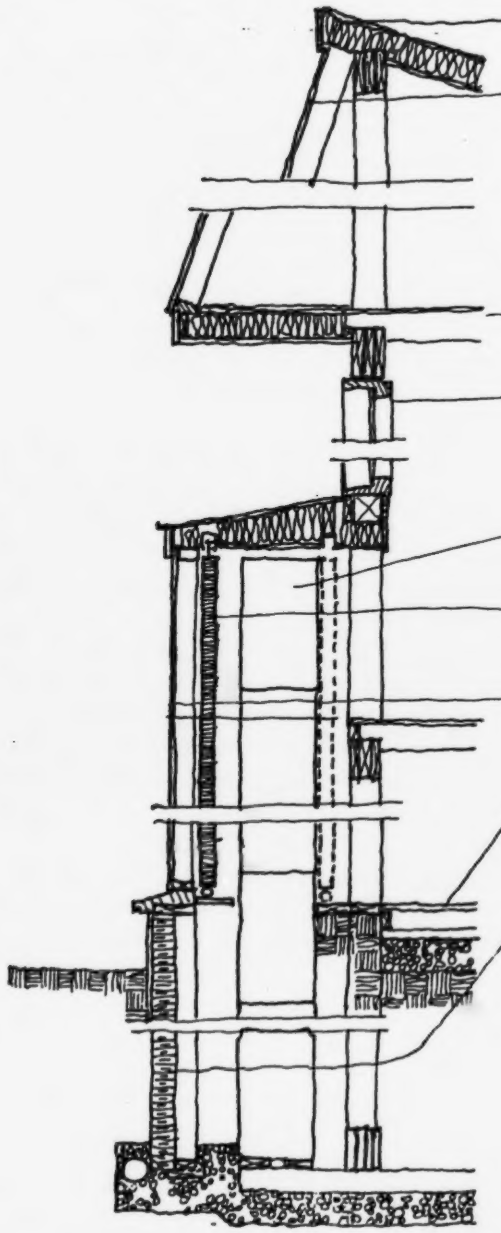
roll roofing on
on ½" plywood
5/8" "Rohaglas" cover
greenhouse
5"x 5" floor joists
at 24" o.c.
'mason' casement
windows
12.5 liter oil
barrels
3" fibreglas
insulating curtain
in closed position
5/8" "Rohaglas"
5/8" plywood on
2"x 4" joists on
2"x 4" sleepers
on 6" gravel
3" fibreglas
insulative drainage
layer/wood foundati

Figure 3.33
Typical Section Through South Wall of Mastassini Unit
Source: Appropriate Building Energy Systems

The waste disposal system suggested by the Shelter Systems Group is the "Humus" composting toilet. In their report they write:

> "When first installed, the toilet was a source of odour in the house. After adjustment of a vent control, the problem was eliminated and the unit was completely satisfactory in its performance for a few months. At that time the odour problem surfaced again, and it was found that there was insufficient moisture and humidity to cause aerobic decomposition and de-ordorization of waste. The "Humus" was removed ... and replaced with a Canadian made ("Improved") version of the Mull-Toa/Humus. The new unit, just installed, can handle greater numbers of users and is repeatedly a more efficient composter."[1]

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[1] Ibid, p. 29.

3.5 Arctic Housing (Northwest Territories, Yukon, Alaska)

3.5.1 General Architectural Information

It appears that, in North America, the greatest progress in the field of remote housing design has been made in areas that experience "Arctic" conditions; namely the Northwest Teritories, the Yukon and Alaska. Problems of moisture control, heat distribution, waste disposal, foundation heaving and conflicts between the need for personal space and social space, all common to the problems found in the lower latitude housing of Northern Manitoba, are greatly magnified by the extreme climate experienced in the "arctic". A poor design will fail quickly in the harsh conditions under which it must co-exist with the environment.

Another possible reason for progress is the location of government sponsored projects and facilities in this region. Adequate housing has had to be supplied to the previously "southern" homeowners working on these projects or in these facilities. Gradually, the techniques and innovations used in non-native housing, has been incorporated into the design solutions proposed for the remote houses of the native peoples.

Out of this search for the ideal arctic house, several good, and at times innovative, designs have emerged. For the purpose of this review, the Design Team has analyzed five design solutions, each with their own characteristics while at times also encompassing similarities with one or more of the other solutions. One potential drawback found in all five designs is their high cost (ranging from an estimated $60,000 to $90,000 per unit). This high cost can be partially attributed to any one or combination of extensive south facing glass area, elaborate heating and ventilation systems, and the quality and amount of interior and exterior finishes that are specified.

3.5.2 Plans, Sections, Elevations of Selected Arctic House Designs

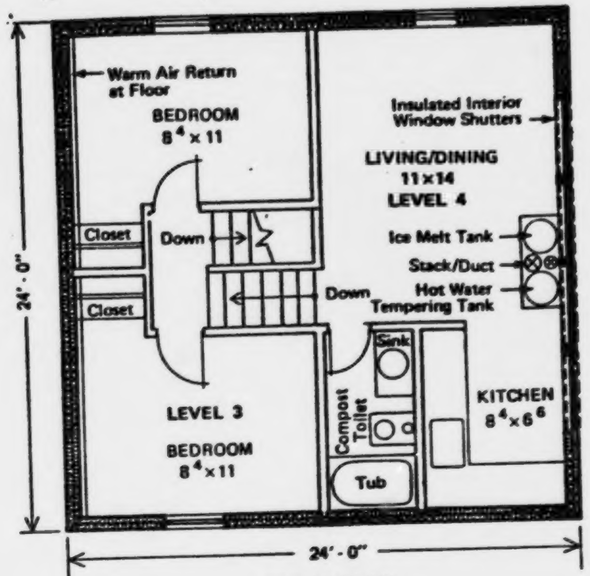
Figures 3.34 (Sheet 1 and 2) is a design solution proposed by Mr. J. Ross, intended for construction in rural Alaska. It is planned to utilize straightforward energy conservation features and to allow for construction in intermittent permafrost, and permafrost areas.

Figures 3.35 (Sheet 1, 2 and 3), also from Alaska, is a late 1979 solution proposal by Hia Toh Lim. Its concept is to create a low cost, energy efficient house for Inuit families. It incorporates a specialized heating distribution system to be discussed later.

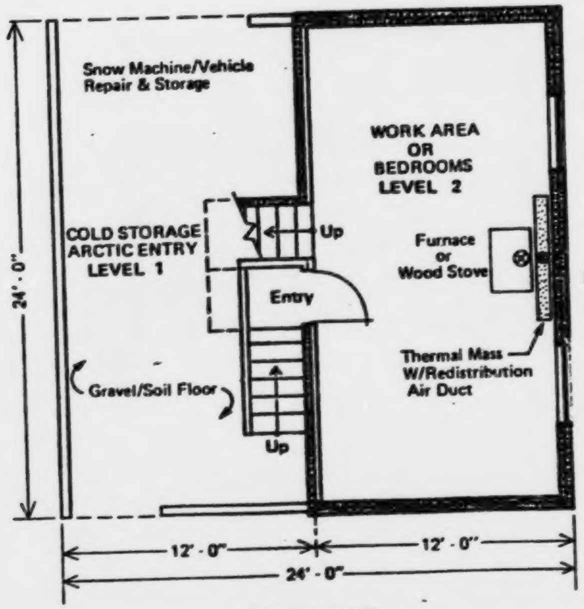
Figure 3.36 is a solution from the firm of Allen, Drerup and White, entitled The Keewatin House. It is intended as a solar efficient house, the first of which was constructed in the Northwest Territories during the year 1980. At the time of writing, no floor plan of the house was available. Its analysis in this review has been based on an article found in Harrowsmith magazine.

Figure 3.37 (Sheets 1, 2, 3 and 4) is Mr. S. Fancott's recent solution for a house located in Yellowknife, NWT. It is an energy efficient design conceived for the Canada/NWT Conservation and Renewable Energy Demonstration Program sponsored by Energy, Mines and Resources Canada.

Figure 3.38, the final solution to be explored in this section, is a design produced for the Inuit people of Rankin Inlet and Eskimo Point, NWT by Shelter Construction and Development Limited of Ontario.


Warm Air Return at Floor
BEDROOM
8⁴×11
Insulated Interior Window Shutters
LIVING/DINING
11×14
LEVEL 4
Closet
Down
Ice Melt Tank
Stack/Duct
Closet
Down
Hot Water Tempering Tank
Sink
Compost Toilet
LEVEL 3
BEDROOM
8⁴×11
KITCHEN
8⁴×6⁶
Tub
24'-0"
24'-0"

FLOOR PLAN

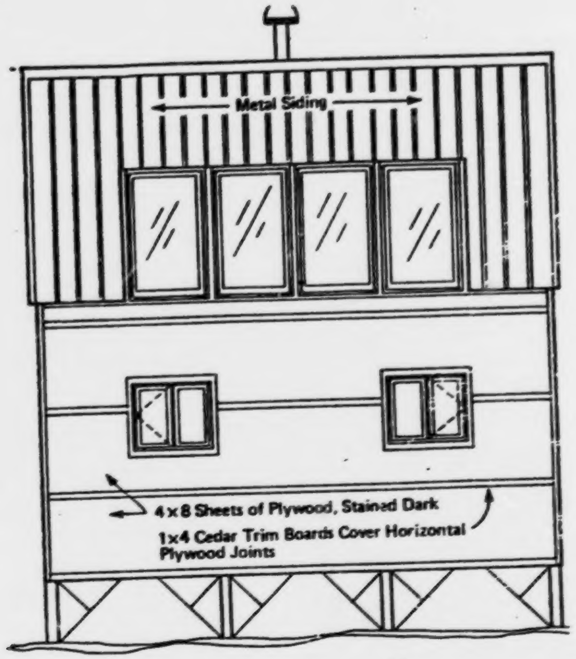

Snow Machine/Vehicle Repair & Storage
WORK AREA
OR
BEDROOMS
LEVEL 2
COLD STORAGE
ARCTIC ENTRY
LEVEL 1
Up
Furnace or Wood Stove
Entry
Thermal Mass W/Redistribution Air Duct
Gravel/Soil Floor
Up
24'-0"
12'-0"
12'-0"
24'-0"

FLOOR PLAN

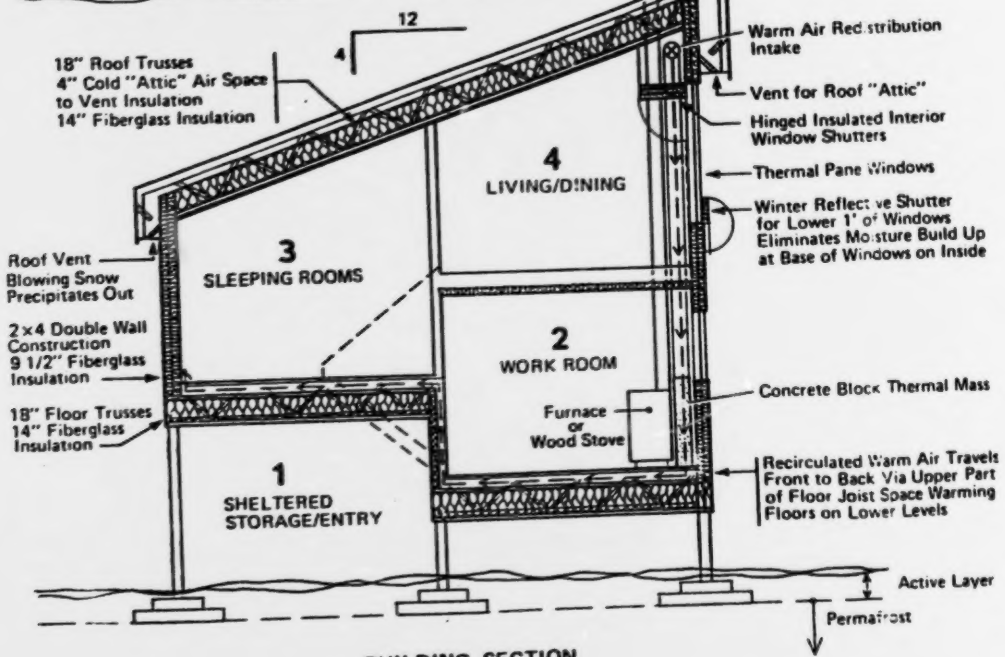
Figure 3.34

J. Ross House (Plans)

Source: Nothern Engineer, Vo. 15, No. 2.


Metal Siding
4×8 Sheets of Plywood, Stained Dark
1×4 Cedar Trim Boards Cover Horizontal Plywood Joints

SOUTH ELEVATION


12
4
18" Roof Trusses
4" Cold "Attic" Air Space to Vent Insulation
14" Fiberglass Insulation
Warm Air Redistribution Intake
Vent for Roof "Attic"
Hinged Insulated Interior Window Shutters
Thermal Pane Windows
Winter Reflective Shutter for Lower 1' of Windows Eliminates Moisture Build Up at Base of Windows on Inside
4
LIVING/DINING
Roof Vent Blowing Snow Precipitates Out
3
SLEEPING ROOMS
2×4 Double Wall Construction 9 1/2" Fiberglass Insulation
2
WORK ROOM
Concrete Block Thermal Mass
18" Floor Trusses 14" Fiberglass Insulation
Furnace or Wood Stove
Recirculated Warm Air Travels Front to Back Via Upper Part of Floor Joist Space Warming Floors on Lower Levels
1
SHELTERED STORAGE/ENTRY
Active Layer
Permafrost

BUILDING SECTION
(SIDE)

Figure 3.34

J. Ross House

(Elevation & Section)

(Sheet 2)

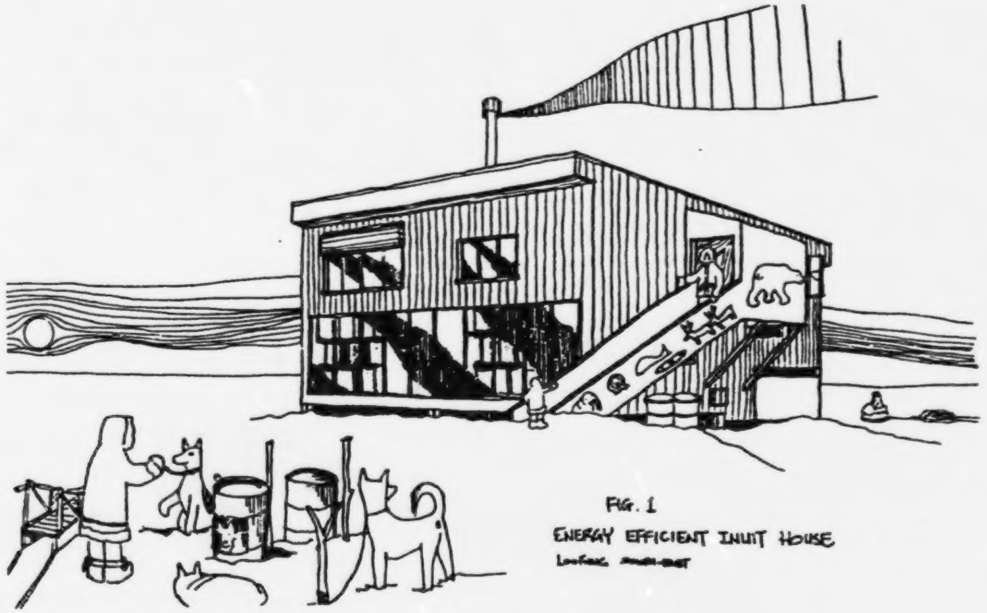
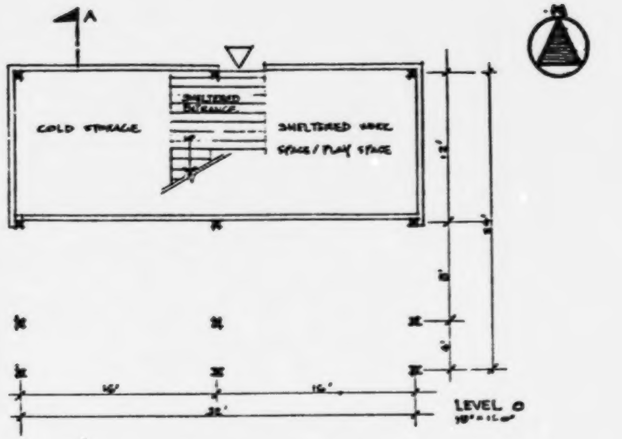


FIG. 1
ENERGY EFFICIENT INUIT HOUSE
Looking north-east

Perspective

Figure 3.35
Hia Toh Lim House Design
(Sheet 1)

Source: The Northern Engineer, Vol. II; No. 3


A
COLD STORAGE
SHELTERED ENTRANCE
SHELTERED WORK SPACE / PLAY SPACE
16'
16'
32'
LEVEL 0

Plan of energy efficient Inuit house, level 0.

Plan of energy efficient Inuit house, level 3' - 9" & 7' - 6" (1/8" = 1' 0").

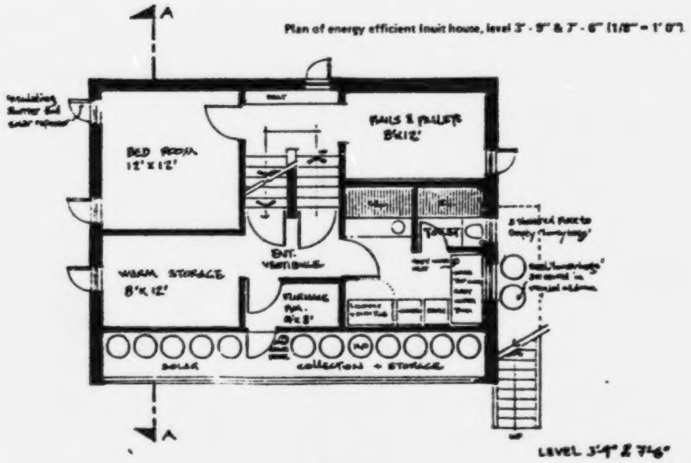
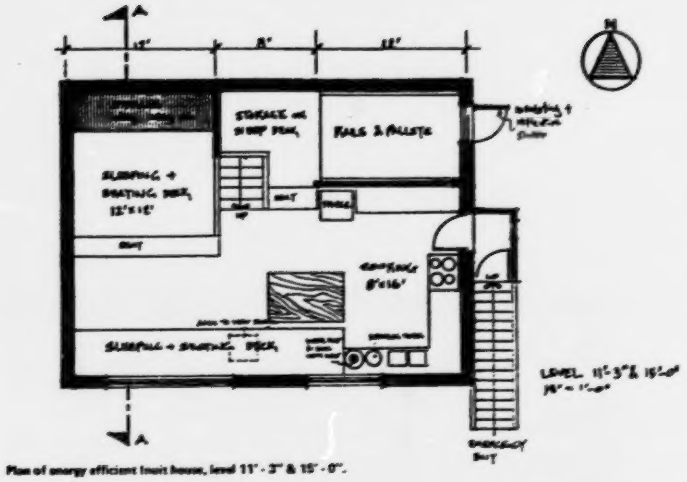

A
BED ROOM
12'x12'
PAILS & PALLETS
8'x12'
TOILET
ENT. VESTIBULE
WARM STORAGE
8'x12'
FURNACE RM.
8'x8'
SOLAR
COLLECTION + STORAGE
A
LEVEL 3'-9" & 7'-6"

Figure 3.35
Hia Toh Lim House Design
(Plans of Level 0 and Level 1)
(Sheet 2)


A
12'
8'
12'
STORAGE or SHOP DESK
FUELS & PALLETS
SLEEPING + SEATING DECK, 12'×15'
COOKING 8'×16'
SLEEPING + SEATING DECK
LEVEL 11'-3" & 15'-0"
1/8" = 1'-0"
EMERGENCY EXIT

Plan of energy efficient Inuit house, level 11' - 3" & 15' - 0".

Section A - A of energy efficient Inuit house.

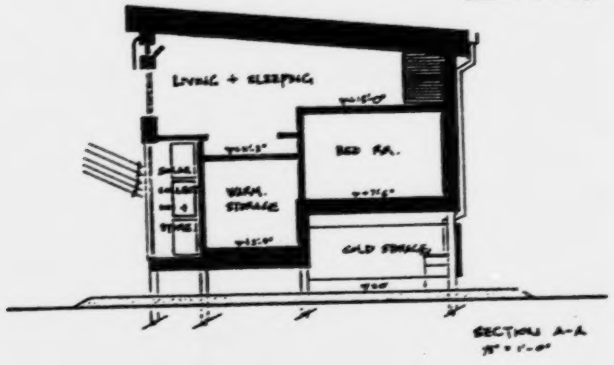
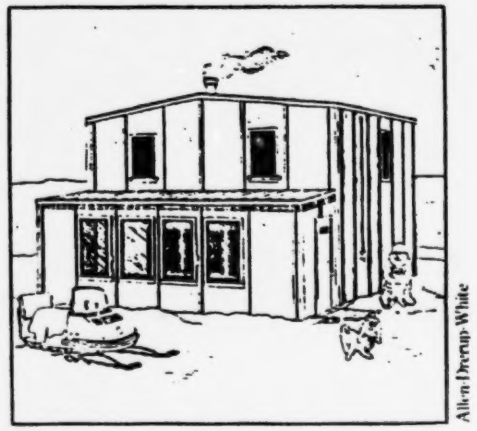

LIVING + SLEEPING
BED RM.
WARM. STORAGE
COLD STORAGE
SOLAR COLLECTOR
SECTION A-A
1/8" = 1'-0"

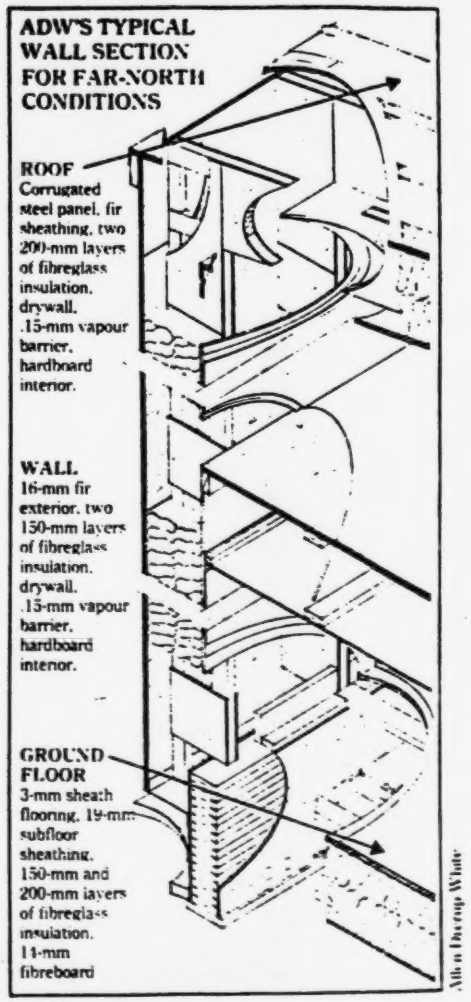
Figure 3.35
Hia Toh Lim House Design
(Plan of Level 3 and Section)
(Sheet 3)



Allen-Drerup-White

Perspective

Figure 3.36
Allen, Drerup, White
"Keewatin House"
Source: Harrowsmith, #41,
Feb./Mar. 1982.



ADW'S TYPICAL WALL SECTION FOR FAR-NORTH CONDITIONS

ROOF
Corrugated steel panel, fir sheathing, two 200-mm layers of fibreglass insulation, drywall, .15-mm vapour barrier, hardboard interior.

WALL
16-mm fir exterior, two 150-mm layers of fibreglass insulation, drywall, .15-mm vapour barrier, hardboard interior.

GROUND FLOOR
3-mm sheath flooring, 19-mm subfloor sheathing, 150-mm and 200-mm layers of fibreglass insulation, 14-mm fibreboard

Allen-Drerup-White

Section
Through Building Envelope

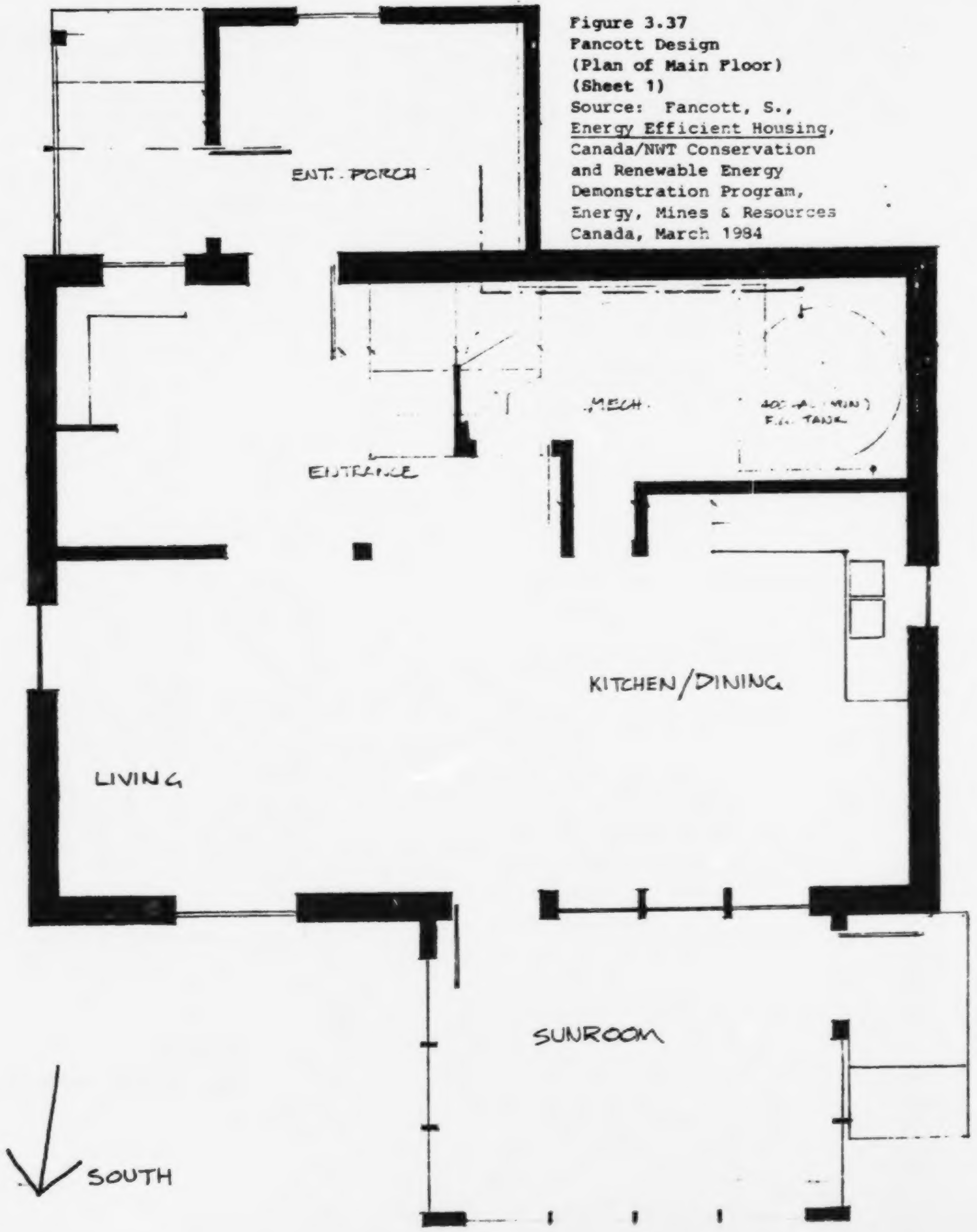

ENT. PORCH
ENTRANCE
MECH.
400 GAL (MIN) F.O. TANK
KITCHEN/DINING
LIVING
SUNROOM
SOUTH

Figure 3.37
Fancott Design
(Plan of Main Floor)
(Sheet 1)
Source: Fancott, S., Energy Efficient Housing, Canada/NWT Conservation and Renewable Energy Demonstration Program, Energy, Mines & Resources Canada, March 1984

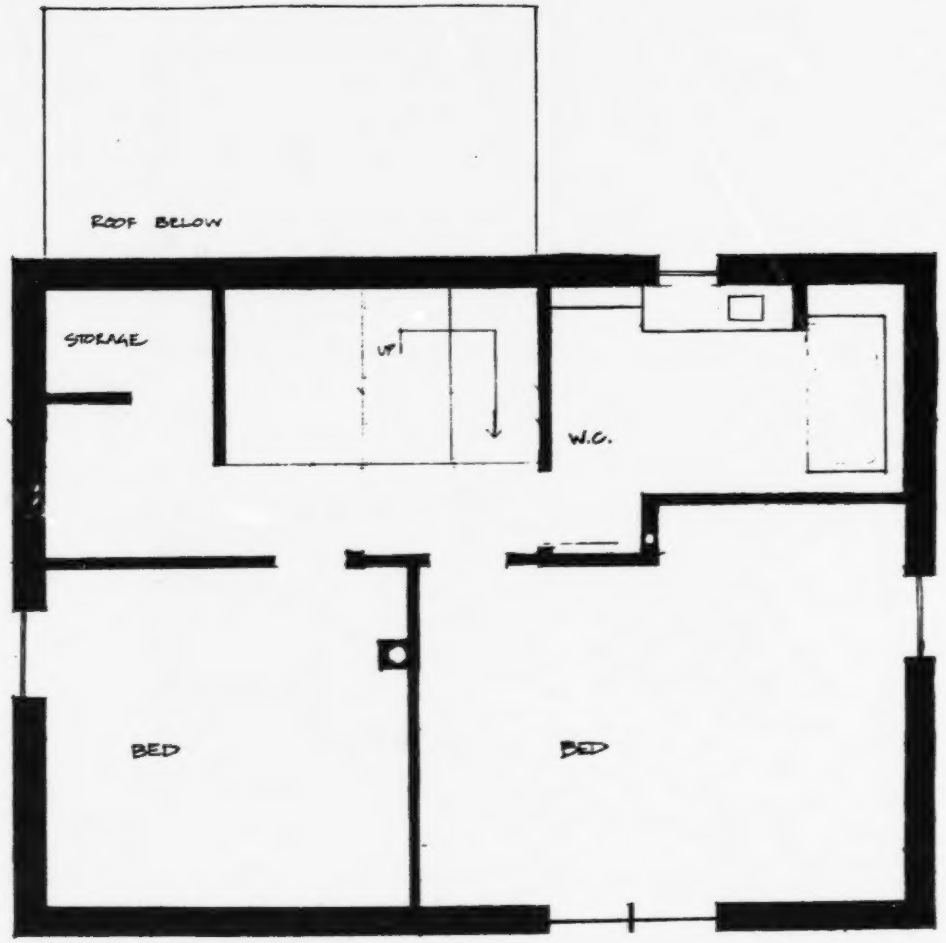

ROOF BELOW
STORAGE
UP
W.C.
BED
BED

Figure 3.37
Fancott Design
(Plan of 2nd Floor)
(Sheet 2)

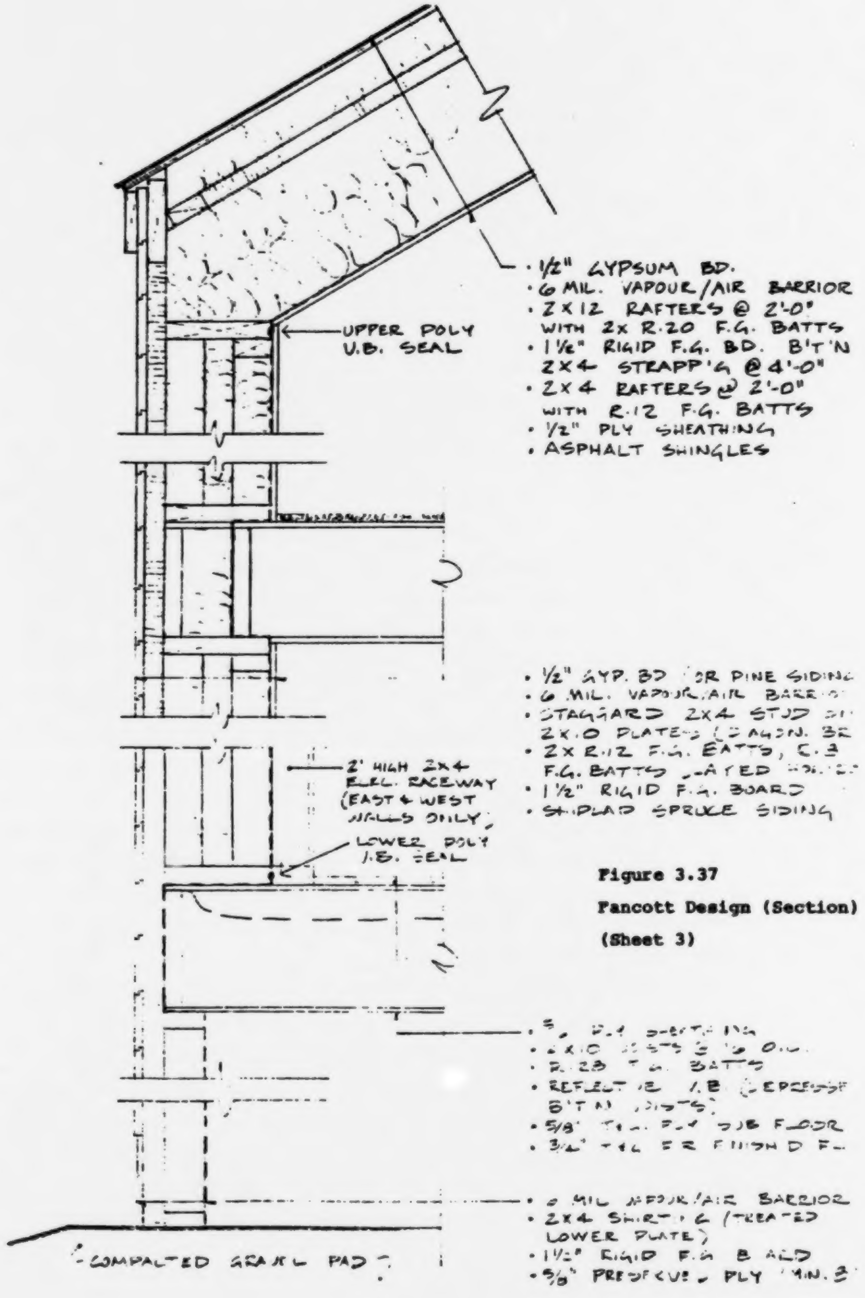
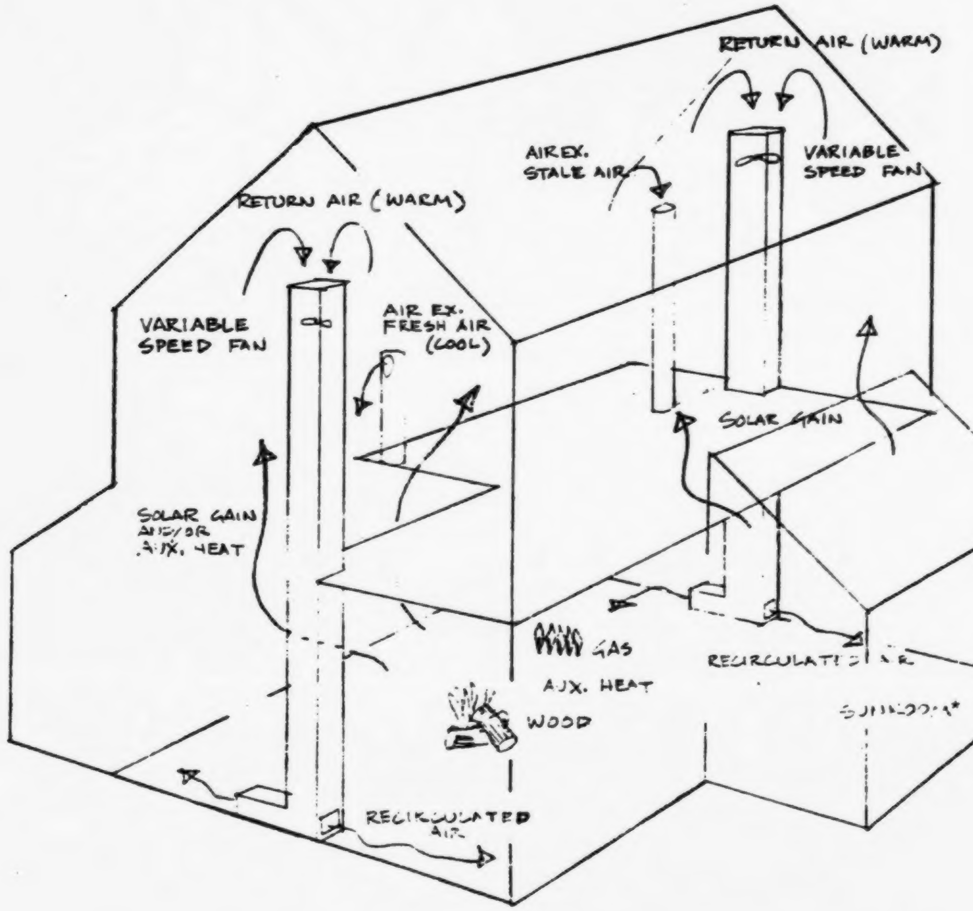

• 1/2" GYPSUM BD.
• 6 MIL. VAPOUR/AIR BARRIOR
• 2X12 RAFTERS @ 2'-0" WITH 2x R-20 F.G. BATTS
• 1 1/2" RIGID F.G. BD. B'T'N 2X4 STRAPP'G @ 4'-0"
• 2X4 RAFTERS @ 2'-0" WITH R-12 F.G. BATTS
• 1/2" PLY SHEATHING
• ASPHALT SHINGLES
UPPER POLY V.B. SEAL
• 1/2" GYP. BD. OR PINE SIDING
• 6 MIL. VAPOUR/AIR BARRIOR
• STAGGARD 2X4 STUD ON 2X10 PLATES (DIAGON. BR.
• 2X R-12 F.G. BATTS, R-8 F.G. BATTS LAYED HORIZ.
• 1 1/2" RIGID F.G. BOARD
• SHIPLAP SPRUCE SIDING
2' HIGH 2X4 ELEC. RACEWAY (EAST & WEST WALLS ONLY)
LOWER POLY V.B. SEAL
• REFLECTIVE V.B.
• 5/8" T&G PLY SUB FLOOR
• 3/4" T&G FIR FINISHED FL.
• 6 MIL VAPOUR/AIR BARRIOR
• 2X4 SKIRTING (TREATED LOWER PLATE)
• 1 1/2" RIGID F.G. BOARD
• 5/8" PRESSURE PLY
COMPACTED GRAVEL PAD

Figure 3.37

Fancott Design (Section)

(Sheet 3)

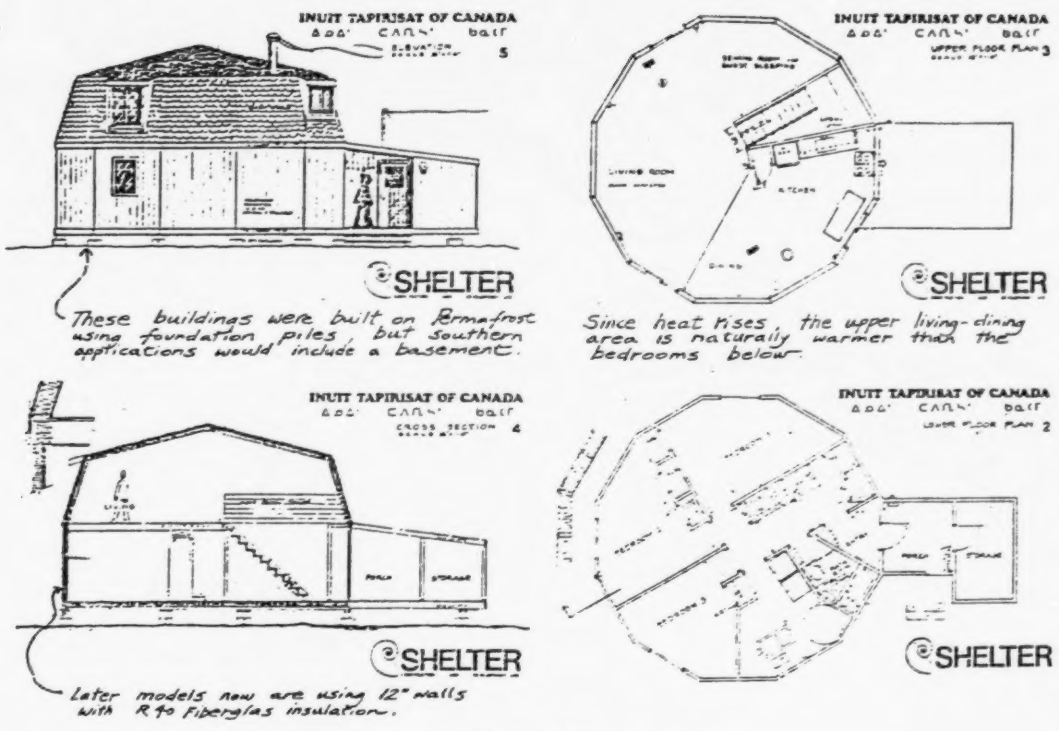

RETURN AIR (WARM)
RETURN AIR (WARM)
AIR EX. STALE AIR
VARIABLE SPEED FAN
VARIABLE SPEED FAN
AIR EX. FRESH AIR (COOL)
SOLAR GAIN
SOLAR GAIN AND/OR AUX. HEAT
GAS
AUX. HEAT
WOOD
RECIRCULATED AIR
RECIRCULATED AIR
SUNROOM*

* Sunroom was not built

Figure 3.37

Fancott Design (Air Circulation)

(Sheet 4)


INUIT TAPIRISAT OF CANADA
ELEVATION
5
SHELTER
INUIT TAPIRISAT OF CANADA
UPPER FLOOR PLAN 3
LIVING ROOM
KITCHEN
SHELTER
INUIT TAPIRISAT OF CANADA
CROSS SECTION 4
LIVING
PORCH
STORAGE
SHELTER
INUIT TAPIRISAT OF CANADA
LOWER FLOOR PLAN 2
PORCH
STORAGE
SHELTER

These buildings were built on Permafrost using foundation piles, but southern applications would include a basement.

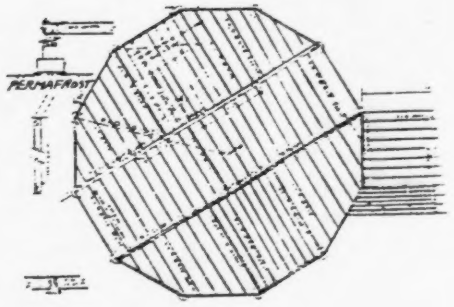
Since heat rises, the upper living-dining area is naturally warmer than the bedrooms below.

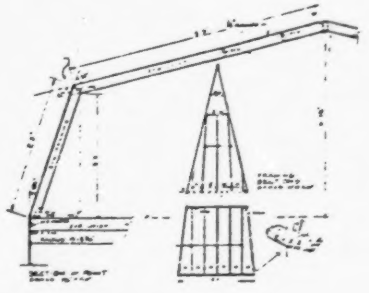
Later models now are using 12" walls with R40 Fiberglas insulation.

Figure 3.38

Shelter Corp. Inuit House Design

(Plans, Elevation Section and Details)


PERMAFROST



3.5.3 Functional Considerations

3.5.3.1 J. Ross House

With a total floor area of 864 square feet, J. Ross's design (Figure 3.34) shares with the other Alaskan designs the trait of comprising a series of alternating half levels. These half levels provide an effective means of separation between various activity areas within the house while at the same time allowing the day areas to be located at the warmest level of the house and least used at the coolest. At ground level is found a protected area for cold storage and exterior maintenance work. It is through this area that one passes to reach the staircase leading up to the vestibule entrance of the house. This raised vestibule helps to prevent cold air from entering the house, and heated air from leaving. The vestibule opens into a 288 square foot warm work area. Partitions of this work area could be performed be provide extra bedrooms as the family's size increases. The original two bedrooms provided in the plan are located on a level midway between the lower work area, and the higher living/eating area. The highest floor level is where the majority of the family's daily activities will occur. A distinction has been made between the public and private zones within the house through the use of these level changes.

The plan itself works quite well, but the location of the bathroom on the highest level leaves much to be desired. In houses utilizing the "honey bucket" waste disposal system, one must travel down three flights of stairs to reach ground level, leaving great opportunity for accidental spillage along the way.

There appears to be adequate storage facilities as the plan provides for over 500 square feet of storage area divided evenly between the cold area at ground level, and the warm work area. This large area is diminished easily if the family converts some or all of the warm work area into bedroom space. This could create a lack of adequate storage space when it is needed the most by the now larger family. The location of the cold storage area directly below the bedrooms helps to minimize heat loss from occurring through the bedroom floor.

3.5.3.2 Hia Toh Lim Design

Hia Toh Lim's design (Figure 3.35) encloses 1400 square feet of living space, with an additional 358 square feet of enclosed cold storage space and a sheltered work/play area. This design is very flexible with the main day area located highest in the house. The only formal bedroom is located midway between the living level and the warm work area is on the lower level. One enters the building up a set of stairs from a sheltered alcove located above ground level, through a small vestibule and into the warm work/utility level of the house. Besides the main entrance, there is also an emergency exit (also with a vestibule) located just off the kitchen/dining area of the upper level. By having the entrance from below, heat will remain trapped in the house as the entrance is used. The upper floor incorporates several level changes itself, through the use of raised decks and seating/sleeping platforms.

The majority of this space has been left open to allow for the homeowner to subdivide as he or she wishes, using moveable fabric curtains. This allows the use of the entire space during the day, and then converting it into sleeping quarters at night. The use of built-in seating areas and platforms helps those families without the monetary resources to enable them to purchase their own furniture, but at the same time, takes away from the overall flexibility of the space.

Two rooms within the house have been designated as using the "rail and pallet"[1] system. Evenly spaced 2" x 4" rails are fastened horizontally along the length of two opposing walls within these rooms. Four foot wide pallets span the width of the room, supported at each end upon the rails. The arrangement of these pallets can be modified to suit the changing needs of the homeowner and his family. Pallets are also intended to serve as sleeping platforms as well. These open-ended rooms lend themselves readily to the flexible open-plan concept proposed. In using this open style of planning, distinction between public and private spaces within the house has, for the most part, been sacrificed. It would be difficult to find quiet areas for study or for sleeping, while other noisier activities are taking place, as no special area has been has been set aside for quiet activities. A total of 352 square feet of interior and exterior storage space is possible, excluding the rail and pallet rooms. The bathroom is located within a general utility room located on the first half level, within easy walking distance of the main entry to the house.

3.5.3.3 Allen Drerup and White House Design

The floor plan for Allen, Drerup and White's design was unavailable at the time of this writing. However, Figure 3.36 shows a perspective of the house and a typical section detail. It appears to have excellent potential for flexibility due to its use of clear span floor hoists and roof trusses. The total enclosed floor area of this two story structure is 1300 square feet. The sun-porch on the south side of the house acts as a vestibule for the main entrance, but can also double as a passive solar collector. Once the porch is heated by the sun, dual pane windows separating the house from the porch may be opened to allow the warm air from the porch to circulate throughout the rest of the house. This porch, with its extra wide door to the exterior, allows machinery (such as snowmobiles) or animals, a sheltered environment so that work can be done.

3.5.3.4 S. Fancott Design

The 1320 square foot design by Mr. S. Fancott (Figure 3.37) is also two stories high, utilizing a traditional layout of activity areas within the house. The open plan style of kitchen, dining, living areas are located towards the front of the first floor, while two bedrooms, a lounge/study nook, and the bathroom are located on the second floor. For our purposes, the location of the bathroom is inadequate as it is such a large distance from the exit. An entrance foyer and mechanical room are located towards the rear of the first floor. The rear entrance to the house is through a vestibule which appears as an appendage to the north side of the house. With a little reorganization of the foyer, the vestibule could be better integrated into the overall design. The front door is poorly located in that it opens directly into the living/dining area. In the basic plan, no vestibule has been provided for. An optional sun-porch for the south side could also double as a vestibule, but this but this option would be unfeasible for remote housing in northern Manitoba, where glass is expensive to ship and difficult to obtain. More often than not, broken windows are covered with wood or cardboard over the winter. The layout of this design is somewhat flexible, but the use of cathedral ceilings necessitates the use of load bearing walls or posts. Generally it is an adequate solution following traditional design practices, and with such modifications as relocating the bathroom, adding a third bedroom (option) and incorporating the vestibules into the overall scheme a little better, it could be adaptable to our purposes.

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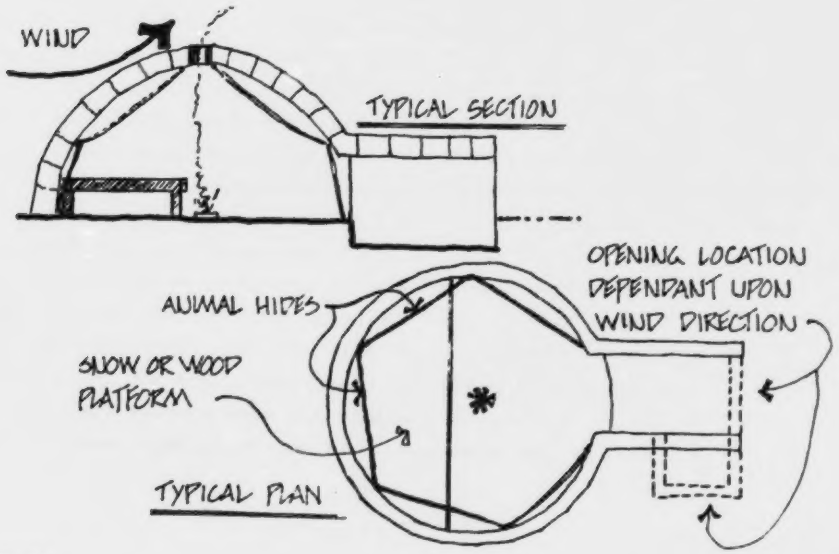
[1] Northern Engineer, Vol. II, No. 3.

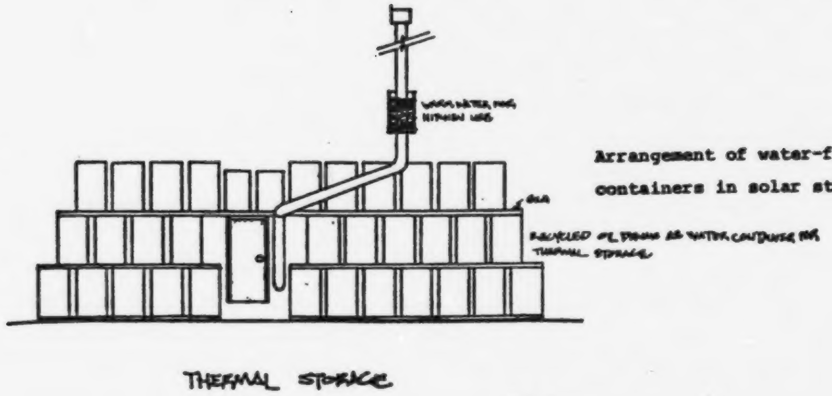
3.5.3.5 Shelter Corp. House Design

The unique twelve-sided house by Shelter Corp. (Figure 3.38) encloses 1400 square feet of living space within two stories. It is modelled after that traditional Inuit winter home, the igloo. By comparing sections and plans from the house (Figure 3.38) and from an igloo (Figure 3.39 below), the similarities became readily apparent.

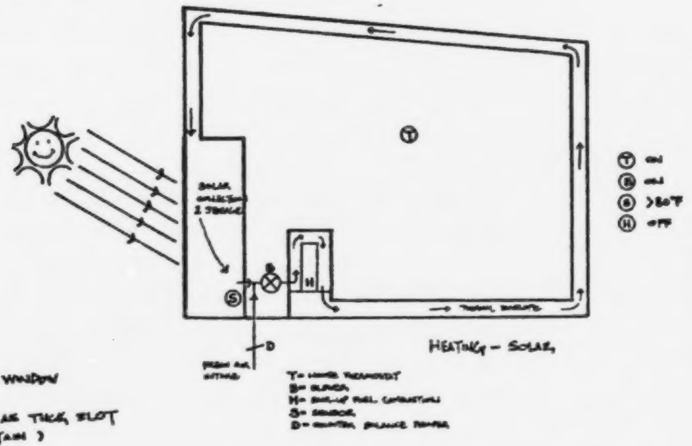
Figure 3.39
Similarities of the Shelter Corp. House & the Traditional Inuit Igloo



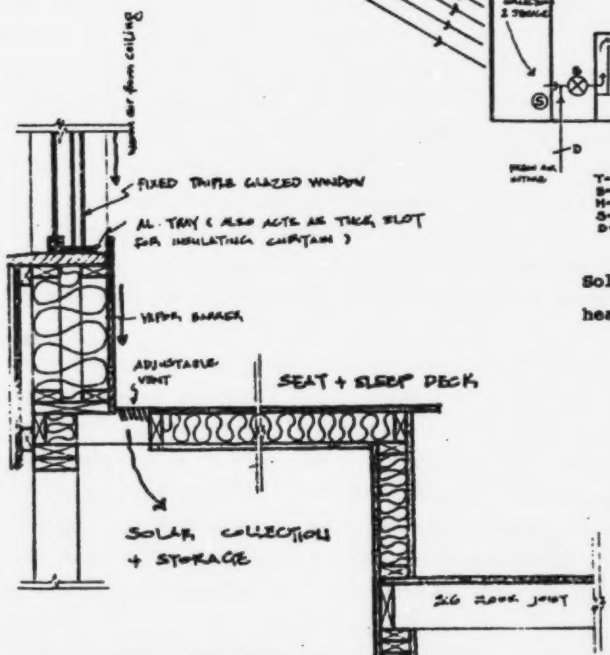
The double vestibule entrance of the house (through an enclosed porch and then through a vestibule) attempts to replace the "heat trap" method utilized in the igloo (enter from a lower level than the actual "floor" level). The near circular shape in plan, and curved form in section, allows for limited surface area to obstruct wind flow, thus helping to reduce heat loss from the structure and reduce drifting of snow around the house. A cold storage and sheltered work area has been provided which is also accessible from the porch, opposite the entrance to the house. Within the house, public and private spaces have been located on separate floors. One enters the house via the cooler bedroom area, and climbs a set of stairs to reach the warmer "day" area above. The entire second floor is virtually unobstructed by partitions, thus allowing for a feeling of spaciousness within the 30 foot diameter house. The bathroom is conveniently located on the first floor, close to both the bedrooms and the exit from the house. Shown as a three-bedroom design, this solution could be expanded to four bedrooms by converting the hobby/guest area into a bedroom when the need arises. One possible shortcoming of this design is the lack of warm storage areas besides the closets in the bedrooms and cupboards in the kitchen. Additions to this structure are not practical due to its complex geometry.


WARM WATER PIPE, KITCHEN USE
SILL
RECYCLED OIL DRUMS AS WATER CONTAINERS FOR THERMAL STORAGE
THERMAL STORAGE

Arrangement of water-filled containers in solar storage


SOLAR COLLECTION & STORAGE
Ⓣ ON
Ⓑ ON
Ⓢ >80°F
Ⓗ OFF
THERMAL DRAFTS
D
FROM AIR INTAKE
HEATING – SOLAR,
T= HOUSE THERMOSTAT
B= BLOWER
H= BACK-UP FUEL CONNECTION
S= SENSOR
D= COUNTER BALANCE DAMPER

Solar collecting and heating. (above)

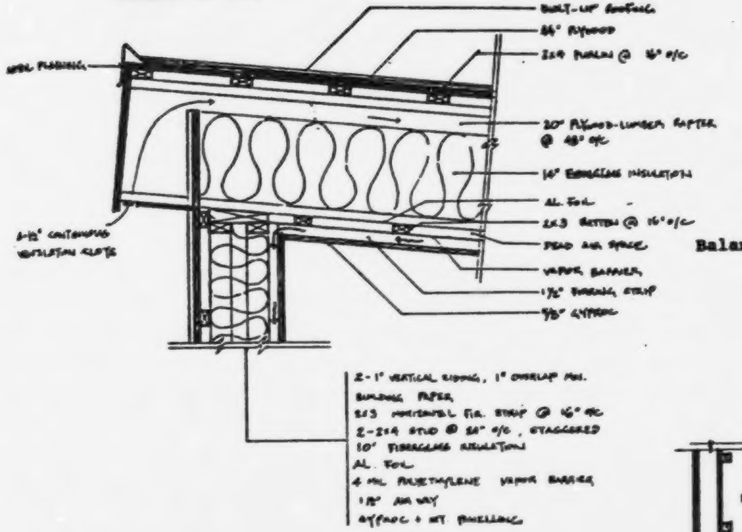

warm air from ceiling
FIXED TRIPLE GLAZED WINDOW
AL. TRAY (ALSO ACTS AS TRACK SLOT FOR INSULATING CURTAIN)
VAPOR BARRIER
ADJUSTABLE VENT
SEAT + SLEEP DECK
SOLAR COLLECTION + STORAGE
2x6 ROOF JOIST

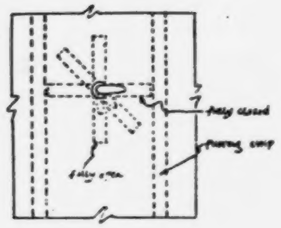
Thermal Envelope at south windows

Figure 3.40
Lim Design Heating Ventilating & Air Conditioning (HVAC) System
(Sheet 1)

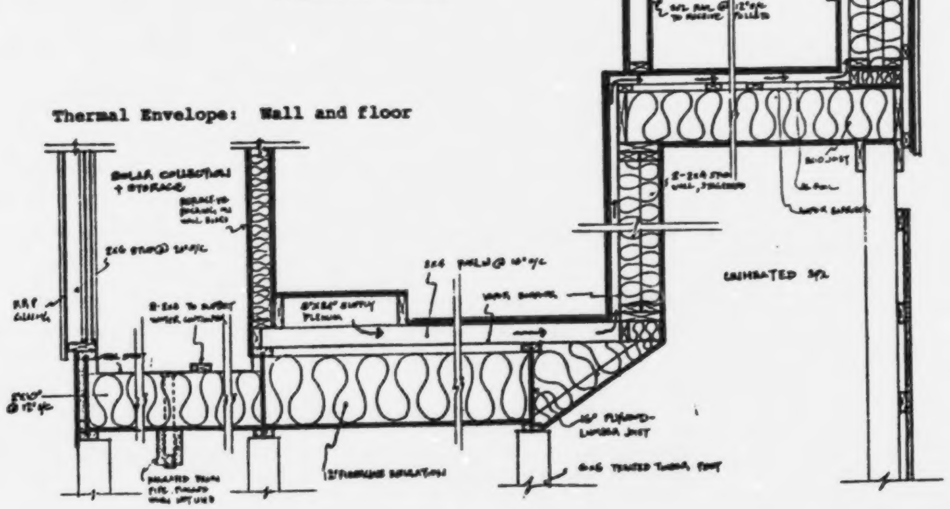
Figure 3.40
LIM Design Detail (HVAC System)
(Sheet 2)

Detail at Roof


METAL FLASHING
BUILT-UP ROOFING
3/4" PLYWOOD
2x4 PURLIN @ 16" o/c
20" PLYWOOD-LUMBER RAFTER @ 48" o/c
14" FIBERGLASS INSULATION
AL. FOIL
2x3 BATTEN @ 16" o/c
DEAD AIR SPACE
VAPOR BARRIER
1½" FURRING STRIP
5/8" GYPROC
2-1½" CONTINUOUS VENTILATION SLOTS
2-1" VERTICAL SIDING, 1" OVERLAP MIN.
BUILDING PAPER
2x3 HORIZONTAL FIR. STRIP @ 16" o/c
2-2x4 STUD @ 24" o/c, STAGGERED
10" FIBERGLASS INSULATION
AL. FOIL
4 MIL POLYETHYLENE VAPOR BARRIER
1½" AIR WAY
GYPROC + INT. PANELLING


fully closed
furring strip
fully open

Balancing Damper


RAILS-AND-PALLETS
UNHEATED SPACE
SOLAR COLLECTION + STORAGE
2x6 STUD @ 24" o/c
2x4 PURLIN @ 16" o/c
VAPOR BARRIER
2-2x4 STUD WALL, STAGGERED
AL. FOIL
VAPOR BARRIER
16" PLYWOOD-LUMBER JOIST
6x6 TREATED TIMBER FOOT
FIBERGLASS INSULATION

Thermal Envelope: Wall and floor

3.5.4 Social Considerations

As mentioned before, complaints leveled at the remote houses constructed by the government for use within the arctic region are similar to those being voiced about Manitoba's remote houses. Overcrowding, lack of storage space, structural deterioration, poor workmanship leading to an endless need for repairs, etc. are some of those complaints being made. In older remote houses, the rooms have generally been too small. **"Larger rooms are needed which can be arranged in different ways depending on the number of people sleeping in the room,"**[1] and hence designs such as Hia Toh Lim's which uses sleeping decks and the rail and pallet system have been provided. It has been suggested that no bedroom be smaller than 120 square feet, and that all rooms be enlarged accordingly. It has also been noted that three bedroom houses do not meet the needs of all potential homeowners. The traditional three bedroom bungalow, the most common of remote house types, proves to be both easily overcrowded by large families, and unsuitable for single people, or single parent families, who find it difficult to find other accommodation. The following points concerning this situation were mentioned within the Kennedy/Smith study (section 3.2.1):

"1) The families must be given a much greater range of choice in housing that meet more of their individual requirements and their level of acculturation."
"2) The dwelling should be constructed economically and in such a manner in that they are easier to maintain."
"3) The dwelling must have the capacity to improve or expand on a gradual basis."(p. 88)[2]

A common problem to all five designs being reviewed in this section is that each includes at least two levels connected by a flight of stairs, and so being are inaccessible to many of the elderly and the handicapped. Modifying these plans while maintaining the integrity of the solutions would be extremely difficult. A possible compromise would be to place all of the "day" areas as well as at least one area for sleeping at, or near ground level. The unhandicapped members of the family would have access to the other levels where bedrooms, storage areas, and work areas would be located.

3.5.5 The Building Envelope

3.5.5.1 J. Ross Design

Wood frame construction techniques are used in all of the designs under examination in this section, including Mr. J. Ross's (Figure 3.34). The walls in his solution are double staggered 2" x 4" framing insulated to R32 using glass fibre batts. The exterior cladding consists of 4' x 8' sheets of plywood with the joints covered with cedar trim. A clear span, 'cathedral' type ceiling is composed of 18" deep open web wood trusses, as are the floor joists. Both are insulated to about R48 with glass fibre batts. The interior wall, ceiling and floor surfaces have a 6 mil polyethylene vapor barrier which is covered with 1/2" drywall on the walls and ceiling, and 1/2" plywood sheathing on the floor.

The proposed foundation, system designed for permafrost conditions, utilizes piles supported upon concrete pads located just at the surface of continuous permafrost. Wood beams supported by the piles, provide support to each end of the truss floor system.

An open air space is maintained between the ground and the bottom of the insulated floor trusses to help minimize heat transfer to the ground which could result in heaving due to thawing of the permafrost. The major wall and glass area of the house faces south to receive the benefit from what sun there is, while the smallest wall area faces north to help minimize heat loss. The larger of the south facing glazing also utilizes shutters which fold up towards the ceiling. A short section of shutter has also been placed on the outside to help prevent moisture condensation on the glass.

The use of a truss system lends itself to premanufacture; either at a few centralized locations, or within each community receiving the houses. This greatly simplifies construction of the houses for unskilled labour, but special care will have to be taken to ensure proper placement of the vapour barrier, especially with the air circulation path proposed within the floor truss system. This structure meets fire rating requirements of the building code, but the use of only one egress from the house, especially when it opens directly under the bedroom floor, poses a potential hazard. Thought should be given to incorporating another exit from the house as has been done in Hia Toh Lim design.

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[1] M. Glover, ed. Building in Northern Communities, A Report on a Conference - Workshop, June, 1974.

[2] Kennedy/Smith Associates, Architects, Housing Study: Isolated Communities and Indian Reserves, Prairie Provinces, First Stage Report Produced for CMHC, August 1967, Winnipeg.

3.5.5.2 Hia Toh Lim Design

Hia's solution (Figure 3.35) makes use of double staggered 2" x 4" frame walls insulated to R32 as well. The floor joists (insulated to R40) and the rafters (insulated to R48) are both constructed of 2" x 4" flanges with 1/2" plywood as webbing material, also making them suitable to premanufacture operations. On the interior of the structural components is affixed paper backed aluminum foil with the reflecting surface facing into the living space, over which is then placed the 6 mil polyethylene vapour barrier. 2" x 2" framing provides an air space between the vapour barrier and the interior drywall finish to allow for fan induced air circulation to occur as part of the heat distribution system (see Figure 3.35).

The foundation consists of piles supported on concrete pads. These pads and piles should be installed for at least one winter to allow their acclimatization with the environment before actual house construction begins. The majority of glazed area occurs on the south facing wall of the house where a passive solar collector is located within the house structure.

One small window faces north and limited windows have been placed facing east and west. All of the windows are triple glazed. The north facing window has a shutter, while insulating curtains are provided for the south windows during periods of no sun. The inner panes of glass on the south side are sealed, while the outer panes are vented to the exterior. The design also meets fire code regulations, and the incorporation of both the lower and upper exits is highly desirable. Care should be taken to specify that only non-flammable fabrics be used for the moveable partitions which the homeowner may want to install.

3.5.5.3 Allen Drerup & White House

Premanufacturing of all three components (wall, roof and floor) of Allen, Drerup and White's design (Figure 3.36) is possible in that each uses different lengths of the same sized flat truss. These trusses have 2" x 4" flanges held in place by plywood gussets. The space between the flanges is insulated with 1 1/2" rigid extruded polystyrene. The use of this truss system greatly simplifies the task of on site construction using non-skilled labour. The 16" (400 mm) deep trusses are insulated to approximately R52 with glass fibre batts in all three components. The rafters are sheathed on the exterior with fir plywood and steel decking, the walls with 1/2" plywood and battens, and the floor with 1/2" hardboard to hold the insulation in place.

On the interior, the walls and cathedral ceiling are covered with 1/2" drywall, and the floor with 1/2 plywood subflooring. The entire interior surface is then covered with a 6 mil polyethylene vapour, which is in turn covered with 1/2" hardboard on walls and ceiling, and 1/8" (3 mm) sheath material on the floor. This method of finishing the interior adds greatly to the stability of the structure, the ease of applying the vapour barrier, and the overall durability of the interior surfaces. The entire structure sits on a "perimeter grade beam above a gravel bed, creating a sealed, draft free crawl space insulated from the house. Should permafrost buckle, the house can be adjusted by jacking at the corners." (p. 63)[1]

3.5.5.4 S. Fancott House Design

A detailed section of Stephen Fancott's design is shown in Figure 3.37 (Sheet 3). As outlined by the designer within his report on the house, it is constructed:

> "... using double staggered 2" x 4" framing technique on 2" x 10" plates with exterior insulated sheathing: 1-1/2 rigid fibreglass. There are four layers of insulation totalling R40 ... The roof structure is 'cathedral' type two way grid design using intermediate girts and two sets of rafters (2" x 12" and 2" x 4"). R value is 60. The floor is insulated to R30 and includes a 1-1/2" air space backed by a reflective vapour barrier. The crawl space skirting is to R19 ..."(p. 2)[2]

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[1] Harrowsmith, #41, Feb./Mar. 1982.

[2] Fancott, S., Energy Efficient Housing, Canada/NWT Conservation and Renewable Energy Demonstration Progra, Energy, Mines and Resources Canada, March, 1984.

The house itself is built on a compacted gravel pad, with the crawl space being skirted in to prevent air flow under the floor. Dual pane windows were used throughout, each with its own shutter of R5 to R10 and a removable third pane made of acrylic. The house meets fire code regulations, and with the use of two exits facing in opposite directions a quick means of exist should be readily available.

3.5.5.5 Shelter Corporation House Design for the Inuit

While the previous designs used double wall construction techniques and trusses, Shelter Corporation's design departs from this and uses more traditional wood frame construction. The walls, roof and floor use 2" x 6" framing members that have each been insulated to R20 with glass fibre batts. The construction of this house is complicated by its twelve sided configuration and unique rafter layout. The rafters form a web-like structure (Figure 3.38) which meets in the centre at a compression ring. A temporary frame-work will be required to hold this compression ring in place until all of the rafters have been installed. This design meets all fire code regulations but could use another exit from the house, i.e., perhaps an emergency exit from the second story out over the roof of the porch and storage room.

3.5.6 Mechanical Systems (Heating/Ventilation/Waste Disposal)

3.5.6.1 Heating/Ventilation

It is within this area that some of the solutions proposed by the designers become quite elaborate.

In discussing his system, Mr. J. Ross writes that the heat:

> "comes from a furnace or wood stove and from passive solar gain. The furnace or stove is located at the lowest level so that hot air will rise and benefit the upper levels, while the radiant heat warms the lower level ... The exhaust stack from the heat source passes through the house to help heat the living spaces .... The heated air in the house rises to the upper part of level floor, where a duct with a fan sucks the warm air down to the lower floor spaces. This recirculated air can be filtered, then used to warm both the work room floor, and then filtered into the bedrooms, along the north wall."[1] (p. 10)

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[1] J. Ross, Northern Engineer, Vol. 15, No. 2 (See Figure 3.34 (Sheet 2))

When using such a system care will have to be taken to ensure that the stove unit and exposed chimney are inaccessible to children who could burn themselves, and that smoke detectors connected to the recirculating fan, be installed to turn off the fan if there is a fire, to help stop the distribution of smoke throughout the house which would otherwise increase the risk of the occupants being overcome by the smoke and not being able to get out.

Hia Toh Lim's heating system becomes a little more elaborate in that the use of passive solar heat gain takes on a much greater role. The majority of the south wall is glazed with triple pane units, behind which are located water filled oil drums that constitute a large thermal mass. Heat is transferred from these oil drums to air which is circulated down past them by a thermostatically controlled blower, which then transfers this warm air through a loop within the inner surface of the building envelope (see Figure 3.40 (sheets 1 and 2)). In this way "a zone of comfort encompasses the entire living space with little variance in the temperature throughout the house interior."[1] During periods of cloud or darkness when the heat stored by thermal mass becomes depleted, a sensor incorporated in the outlet air stream of the collector would start a back-up furance when the temperature of the recirculating air falls below a predetermined setting. The furnace is located within the loop, allowing the mechanically heated air it be circulated through the building as before. To help control heat a humidity buildup in the house, fresh air intakes and manually operated dampers have been provided. A vent located at the peak over the south windows may also be opened to allow hot air to be exhausted to the exterior.

In both of the systems just discussed, great care will have to be taken in the location and integrity of the vapour barrier. The recirculating systems call for the warm, humid interior air to be forced to travel within the exterior wall surface next to the vapour barrier, where any tear or unsealed joint, will allow this humid air into the structure, leading to eventual condensation and structure decay. Ross's system is potentially more harmful in this regard as his design calls for forcing the air down from the ceiling and through the truss system under the

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[1] Northern Engineer, Vol. II, No. 3, p. 12.

first and second levels, on the cold side of the vapour barrier. In Lim's design, the air is circulated between the warm side of the vapour barrier and the interior drywall finish.

Fancott's solution is similar to Ross's in that he too uses a fan system to pull air down from the second storey, but instead of directing it into a radiant heat setup, he dumps the air directly into the lower level (see Figure 3.37 sheet 4). This is done to help avoid heat stratification on the second floor, and a cooler first floor. As stated in his report, "in an energy efficient house, heated air will pool at the highest level, and will require mechanical means of reusing this heated air in cooler areas within the house. In Allen Drerup & White's design, a manually switched fan draws air from the peak of the house down to the first floor heating plenum which directs this air to the perimeter of the house. A small space heater which allows heat to be distributed throughout the house via radiation and natural convection, has been utilized. It is hoped by the designers that the sunporch will provide the majority of the heating requirement of the house, with only supplementary heat to be supplied by the space heater.

Insufficient information was available regarding the heating system of Shelter Corporation design to allow a discussion of it in this review.

3.5.6.2 Waste Disposal

The waste disposal means suggested by the Design Team include:

- a standard water borne system common to developed communities, (Fancott's) but unfeasible and uneconomical for our purposes because of the spread out nature of house development in northern Manitoba Indian communities and the soil conditions of the area;
- a compost toilet with a garbage disposal chute connected from the kitchen (Ross);
- a freshwater system fed by a cistern located on the second floor which gravity feeds the bathroom and the kitchen, where from wastes are drained into a holding tank located below the house (Allen/Drerup/White). This tank will require periodic emptying; and finally
- a modification of the "honey bucket" system. The toilet is accessible from the exterior through a hatch located within a sheltered space under the stairs leading to the secondary exit. After opening the hatch, the bucket may be removed and emptied into an old oil drum for storage over winter. In the spring and summer, crews from the community collect these drums for disposal at centralized location (see Figure 3.41).

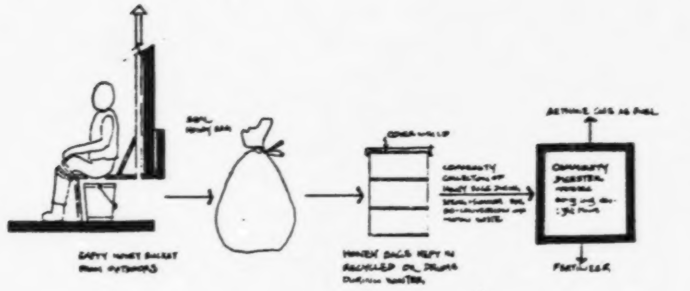
METHANE GAS AS FUEL
COVER WITH LID
COMMUNITY DIGESTER
EMPTY HONEY BUCKET FROM OUTDOORS
HONEY BAGS KEPT IN RECYCLED OIL DRUMS DURING WINTER
FERTILIZER

Figure 3.41
Schematic of pack-freeze-compost human waste handling process.

This helps to ensure the sanitary integrity of the household's living environment, as any accidental spillage would occur outside.

3.5.7 Other Arctic Housing Design Studies and Reports

This section outlines a series of housing design studies and reports collected by the Design Team.

3.5.7.1 Arctic Housing Conference (1974)

The problems and suggestions of the report can be summarized as follows:

- **Site & Foundation Work**

  On-site preparation of the ground should take place one year in advance to stabilize the environment. Prior to the construction of the pads, the ground should be covered with gravel and sloped adequately for drainage.

  A criticism of the design suggested are that the pads are too small and can break apart at the edges. There is a danger of falling off the pad and down a three foot slope. The study suggests that 4'-0" (minimum) berms be used to prevent the current shifting problems. Concrete blocks can be used for footings.

- **Floor, Wall and Roof Panels**

  The stressed skin panels are made from 2" x 4"'s with insulation material in between. The panels are then butted together (with no caulking of the splices). The interior joints are covered with polyethylene vapour barrier or other gasket material with an interior finish. The exterior joints are covered with battens. The problems include differential movement which open joints which can cause leaks in the roof and cold floors. It is suggested that the insulation values should be increased. There should be a skirting around the house to help keep the floor warm with adequate ventilation of the crawl space to prevent the permafrost from thawing.

- **Windows**

  A criticism of the windows is the icing over in winter. A recommendation would be to seal the interior pane completely and provide ventilation in another way. Smaller, triple panes of glass should be used.

- **Doors**

  The doors warp, stick, ice up and, at times, are wrenched from the building by strong winds. The snow buildup will prevent opening and closure which constitutes a fire hazard. It is recommended that vestibules be used. The exterior doors should be loose fitting or should close over rather than within the door frame. Two sets of doors with air locks should be used for easy escape in emergencies.

- **Finishes**

  The study recommends that finishes in general should be washable and durable. Floor finishes should be resistant to scrubbing and cleaning. Ceiling tiles should be avoided because they soak up water vapour and are unwashable. Rather plywood walls and ceiling that can be painted with a water resistant paint should be used.

- **Division of Spaces in the House**

  The criticism of the 3-bedroom standard house is that there are no porches.

  > "Essentially which is required is a large porch or 'air lock' on both entrances to the houses . . . The uses and purposes of the space were
  > - cold storage of food, meat, fish;
  > - unheated space for storing hunting equipment and supplies;
  > - space for tools and equipment;
  > - enclosed working space - free protected from the house.
  >
  > In short "porches are the northern equivalent of basements in the single." (p. 65)[1]

  One design solution is a suspended basement which is unheated. The basement should be at general entry into the house is at ground level.

---

[1] Glover, M., ed., Building in Northern Communities, Feb., 1974.

- **Bedrooms**

The general criticism was that the bedrooms are too small. The recommended minimum size is 120 square feet. The conference noted that "larger rooms are needed which can be arranged in diffrent ways depending upon the number of people sleeping the the room.[1]

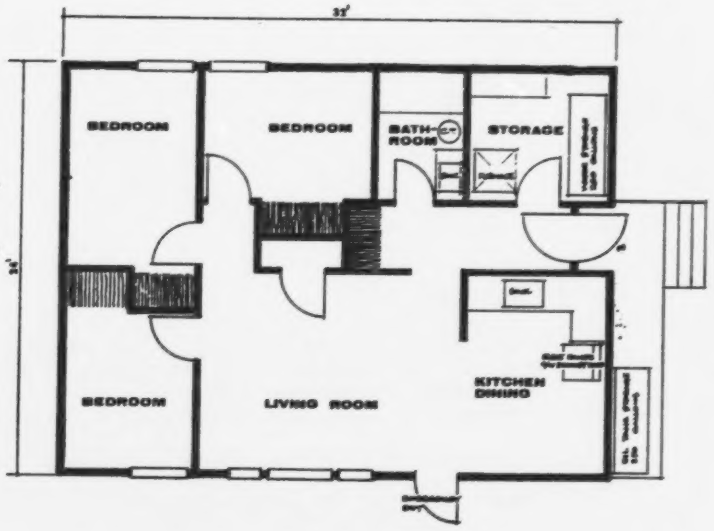

Figure 3.42
Floor Plan of a Standard 3 Bedroom House

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[1] Ibid, p. 66.

- **Concluding Remarks of the Conference**

There were three general complaints:

> "1) The low rental houses are badly constructed and not adequately designed for the northern climate.
> 2) Within the house there is insufficient space. The design is based on southern tradition and not for the people living in the north.
> 3) Three-bedroom houses do not meet all accommodation requirements. Three-bedroom houses are too small for large families with the result that many houses are still badly overcrowded. There is also a large number of single people and single parent families who have difficulty finding suitable accommodation."[1]

One clear reason for all of the problems which have occurred in remote housing to date is that we have tried to do too much with too little money. Instead of trying to produce "x" number at an inflexible, low cost per unit, it is suggested that building half the previous number of houses at double the original per unit cost, would be more beneficial in the long run. The quality of the houses would be better due to less cutting of corners, which would reduce the overall maintenance cost of the houses. The high construction cost of the arctic solutions being reviewed may be for the reason that they have been designed to meet the needs of the people while at the same time be constructed well enough to provide a much longer lifespan than its cheaper predecessors. As Mr. V. Allen stated in the 1974 conference report on building in northern communities;

> "We try to build houses as cheap as we can because we are worried about the budgeting and about the money we can spend. They only give so much money for each community. So at first we built them (houses) out of 2 x 2 and that did not last long and so we built them out of 2 x 4. The point is, why didn't we build things properly to start with? Since housing came to the Northwest Territories, they have given us little boxes, and square boxes and suff like that. By the time we had spent money fixing them up, we had spend much more than if we had built things properly from the start. To build the right house for the north it is going to cost you money sooner or later."[2]

---

[1] Ibid, p. 52.
[2] Ibid, p. 61.

3.5.7.2 Climate And The Built Environment of the North by B. Culjat

John Langdon[1] points out that most of the research in this field (northern housing) deals with "cleaning up the mess", ie. the problems of nuisance, overheating, underheating, wind around buildings, etc., all related to comfort and the economics of comfort maintaining.

> "What's wrong about this process is that we are not taking a general look at "la condition humaine"; we are not taking a general overview of human needs and how building and planning can meet them. The initiate in this process . . . . has from the first to the last been with technology . . . . the technologist merely decides to solve the immediate problem the best way he can. This means that human sciences and knowledge of functional requirements usually come in at the end of the process . . . ."
>
> "Our greatest difficulty is that we do not know enough about, do not pay attention to, these social needs, the goals people are striving to obtain, and the fact that the buildings are supposed to be there only in order to enable them to do so. (p. 14)"

There is a desire to obtain comfort (i.e. satisfaction of physiologic requirements). Some typical characteristics of vernacular northern architecture include small spaces, a sense of enclosure, minimal openings, massive materials.

> "Because the form of the built environment is generated by a whole set of socio-cultural variables, it is not possible to directly apply these vernacular house forms to a different culture, in spite of the seemingly perfect adoption to similar climatic conditions. (p. 56)"[2]
>
> "The lessons that can be learned from vernacular building are the "energy saving techniques" with limited or minimal resources, that such buildings often exhibit."[3]

---

[1] John Langdon: Human sciences as a basis for performance requirements, teaching and teachers on building climatology. Staten's Institute for Byggandsforskning, Stockholm, 1972.

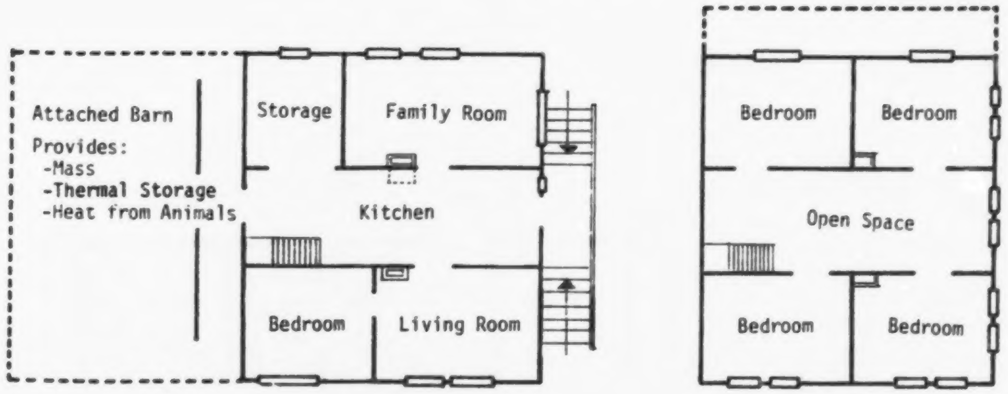
[2] Culjat, B., Climate and the Built Environment in the North, 1975.

[3] Ibid, p. 3.

Figure 3.43

Example: Typical Floor Plan of a Swiss Farmhouse

(Source: Culjat, B., 1975)



Quoting Culjat further:

> "Penetration of light and direct solar radiation into the inside of the building provides in itself the experience of the natural environment, and creates a possiblity for natural elements such as vegetation to be included into the artifact of the building."
>
> Desire to have protection and enclsoure; or at least a psychological feeling of such: does not necessarily mean or imply a complete separation from the outdoor environment. "Being inside is made better by the knowledge of how unpleasant it is to be outside."
>
> "These environmental control solutions are undoubtedly most efficient in utilizing the available energy, which is not of little importance in the areas where additional energy is necessary for survival, but the user loses the opportunity to personally control his own physical environment and adjust it to suit him." (ie. polarizing glass, elaborate shading devices, thermostats controlling solar heating gain, etc., design for wind and snow drifting which would prevent the homeowner to build "additions which may counteract any designed elements creating unwanted snow drifting by entrances, windows, roads, or other neighbouring buildings")."[1]

---

[1] Ibid, p. 100.

> "Even more important that the houses offer better opportunity inside, for personal involvement with the building artifact, ie. for actual physical change."[1]

The examples cited in the study are:

- Use of wood allows for many variations, plans can be open and flexible.
- Need for large storage spaces for equipment, dogs, personal belongings, etc.
- Walls for painting as they wish, changeable furniture, etc.

Building form and organization is key to good design.

- Building form one needs to minimize obstruction - ie., prevention of shadows and relfection of radiation into outdoor and indoor spaces.
- Building details - special devices should be used to reflect desirable radiation and shut off undesirable radiation. Location/size/shape of openings is key.
- Organization - location of outside spaces in relation to surrounding buildings must be considered as well as the location of "day areas" inside buildings for greatest penetration possibilities.

The aim is to create building forms and volumes that are as simple as possible, avoiding protrusions, recesses, etc., both in plan and in section.

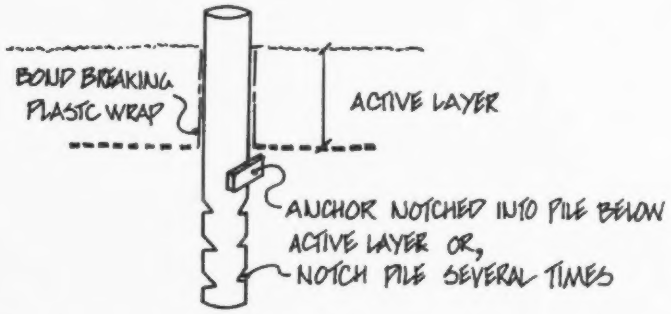
3.5.7.3 Building In The North by E. Rice

Design considerations in the study can be summarized as follows.

- **Fire safety:** Install plenty of warning equipment as well as fire extinguishers. A supply of fire fighting water should be available. One must have ample escape methods. Snow drifting, caulked shut doors, small windows can be a problem. Avoid unaccessibile piping (ie. which may prompt the use of a blow torch if it freezes). One must try to have duplicate facilities in structures well separated.
- **Foundations:** Elevate the building on piles. Insulate floors well enough to prevent cold feeling. This will help prevent homeowners from skirting in the building and thus create the foundation shifting due to permafrost melting. Preventing pile jacking can be accomplished by never letting surrounding soil freeze, or never letting surrounding soil thaw, or anchoring pile against uplift, and breaking the bond of the active layer, or placing piling only in non-frost susceptable soil.

Figure 3.44

Techniques to Prevent Pile Jacking



- **Site planning:** One should locate roads, entry ways and storage areas away from the downwind side of any building that obstructs the free flow of wind. The building should, if possible, be alligned with its narrowest face toward the prevailing wind.
- **Building envelope:** The ideal situation is convenience, comfort with economy in mind. One must maintain close harmony with the environment without seriously effecting the habits of the occupants. This minimum ratio of surface area to volume is required. One should enter the building from below floor level to reduce drafts (ie. the "trapped air bubble"). One must control ventilation and air circulation to remove unwanted heat and stale air. The entrance should be arranged so that it can be easily adapted to varying wind conditions. One should use materials resistant to heat flow wherever possible.

---

[1] Ibid, p. 100.

Doors should permit entry from below to create a warm air-bubble, have the door close over rather than within the door jamb. This allows hinges to be all on one side of the wall and thus will not act as heat conductors. If the entry cannot be accomplished from below, a storm lock is a necessity. It should be straight through for the passage of furniture or for seeing out of on a still summer day. It may be desirable to have a spare door opening in another direction to help in case of drifting or changes in wind directions. Triple pane windows should be used. They should be large enough to escape through in case of fire. They should be situated so that both seated and standing people can see out. One must be careful about heat gain and glare (sun at such low angles even in the summer that shading devices used in southern locations are ineffective in the north (30°-40°). Use of shutters should be considered.

3.6 International Experience

Although an attempt was made to locate examples of northern house design as practised in countries such as Sweden and Finland, no information proved to be readily available for inclusion in the study at this time.

3.7 Log Housing

Recently, a lot of interest has been expressed by the Indian communities concerning the return to log house construction. It is felt that they would be cheaper to build because local trees are used, and that they would be easier to heat and to keep heated because of the thermal mass of the logs. Concerning the first point about local material, in the isolated communities of northern Manitoba, it is hard to find logs of large enough diameter (minimum 8-10" butt diameter) to be useful. The quality of the wood found is questionable, as checking and warping of drying logs has been observed to be prevelant. The time and the labour involved in finding suitable materials, as well as the time included in building the house with short logs, (such as the "Stackwall" technique, where short lengths of logs are placed beside each other and embedded in concrete to form the walls), soon eats away the cost advantage log housing has over standard construction.

As it is mentioned within the Quebec housing (section 3.4), the local wood could be cut into boards and used as vertical exterior siding, or the logs could be split in half and used as horizontal split log siding, thus giving the appearance of a log house while maintaining the thermal efficiency of standard wood frame construction.

The second point concerning the beneficial effect of the thermal mass of the logs is best explained in the article "Log Homes: Myths About Mass" recently appearing in Solar Age Magazine. It explains that the thermal mass of the logs is only effective in regions of the country which experience mild climates. In those areas with very extreme climates for the majority of the year, the thermal mass has no effect on the overall heating performance of the structure. The Solar Age article has been reprinted in Figure 3.45.

CMHC has built several log homes within the province, but inquiries to CMHC did not locate any of the plans which were used.

Figure 3.45

Article from Solar Age, September 1984, (p. 33)

Log Homes: Myths about Mass

"The log homes industry is going to *growl* at you, not just BARK!" wrote Don Hall of Pioneer, Calif., in response to our Questions and Answers column in the June issue.

Solar Age editors aren't impressed with the energy-efficiency of log houses, and we said so in an item titled "Log Homes: All Bark?" Mr. Hall and others in the log home business let us know they weren't happy. "You would be impressed if you talked to the Real Experts," wrote Dave Reed of Justus Log Homes in Seattle. And about a test study conducted by the National Bureau of Standards (NBS), Rob Ridgway, president of Western Log Homes in Denver says, "What you forgot to mention was that the energy savings for the log home *was* greater than (for) other structures tested, despite the 'lower' R-value."

Manufacturers and dealers who thought we unfairly portrayed their product ought to take heart—we are not out to ax log homes. But it seems to us the industry is stretching the facts a bit in its zeal to sell a fine idea. And much of the verbiage about the NBS study was written by people who purely and simply don't understand what it means.

Few deny that wood is a poor insulator with an R-value of under 1.40 per inch. "But," others shout, "thermal resistivity is only part of the story. The mass effect of the logs is equally important in total energy performance." Most of the ammunition for this claim comes from a 1982 NBS study, "A Field Study of the Effect of Wall Mass on the Heating and Cooling Loads of Residential Buildings." We know the original study well, and have read all the magazine accounts that get it wrong.

Let's refresh everyone's memory about the NBS study. The bureau built six test houses in Gaithersburg, Md. (heating degree days equal 3290, cooling degree days equal 1000). The houses were 20 x 20 feet, each with identical floors and roofs. Only the walls varied. They included insulated wood frame (R-12), uninsulated wood frame, outside-insulated masonry, uninsulated masonry, log (7 inches, uninsulated), and inside-insulated masonry. The houses were monitored through a typical year.

Compared with the insulated wood-frame house, the log test home used more energy in the winter and less in the summer and swing seasons. Over the whole year, the two structures used about the same total amount of energy. This by itself refutes the claim that the log home had greater savings than other structures tested. But that's only the tip of the iceberg.

The cozy ambiance log homes create may disguise less-than-heartwarming energy performance. It takes careful thinking and a close reading of the studies to understand why.

Much of the reporting on the NBS study, and most claims by log home sellers, don't mention that the mild climate where the homes were tested limits the findings. NBS said "... the test results of the present study should not be extended to other climates." And the disclaimer, in this case, is important. This is why.

Thermal mass gives the greatest benefits where the outside temperature fluctuates above and below the thermostat set point, day to night. This condition prevails for long periods of the year—much of spring and fall—in mild climates. But *daily* fluctuations above and below 65° to 70°F occur only for short periods in colder, more northerly climates.

Even in the mild climate of the test, the energy savings in the log house during nine months of the year only slightly overcame the energy penalties accrued during the brief winter compared with the wood-frame insulated house. Where winters are more severe, the log home's energy penalties are more likely to win out against the reduced warm- and swing-season benefits.

NBS study participant Doug Burch told *Solar Age* that the mass in log homes is important in the Gulf Coast region and in Southern California, "where you have a spring climate all year long," but that in cold winter conditions R-value is far more important than mass. He also pointed out that "in most climates, the spring contributes a very small amount" to annual energy consumption.

To use the NBS test results to trumpet the triumphs of log homes over "moderately insulated wood frames," as at least one article does, ignores other important issues besides the severe climate limitations of log homes as good energy performers.

First, the mass effect. The test units had no interior partitions or furniture—items that do contain some mass. Had the homes included these, the relative advantages of mass in the log unit would likely have been less.

Second, it is doubtful that the wall construction of the wood-frame unit represented a standard, moderately insulated wall. The test unit had bare plywood sheathing over 2 x 4's, insulated with R-11 batts and finished inside with ½-inch gyp board. Who builds this kind of house in the real world? Not people who care about saving energy. Builders writing in *Solar Age* and energy-conscious agencies have long recommended wall R-values of 19 or more, and the use of air/vapor barriers for cold-climate houses.

You can increase the R-value of stud walls in many ways, as *Solar Age* readers see month after month. But log home builders face a dilemma. To get increased R-value where it does the most good (on the outside, according to the NBS study), they would have to cover the logs. And if they are truly adherents of the value of thermal mass, the NBS study would lead them to build insulated masonry houses with the mass on the inside.

Log homes appeal to us and, as the industry well knows, to thousands of homeowners for reasons that transcend energy savings. But basing a sales pitch on the purported energy advantages of log homes is like setting a bad foundation. It's not responsible and it won't hold up.

For a deeper understanding of the principles at work in log homes and high-mass homes in general, see the article by Bion Howard in this issue of *Solar Age*. ○

"Log Homes: Myths about Mass", from Vol. 9, No. 9, p. 33 of Solar Age, has been reprinted with permission of Solar Age Magazine. Copyright 1984, Solar Vision Incorporated, 7 Church Hill, Harrisville, New Hampshire, 03450, U.S.A.

3.8 House Designs Currently in Use in Northern Manitoba

The Design Team reviewed the house designs provided by selected Manitoba building materials suppliers. In addition, the Design Team has reviewed the plans used by the Island Lake Tribal Council.

3.8.1 McMunn & Yates Designs (Dauphin, Manitoba)

The Design Team reviewed the 24'-0" x 32'-0" bungalow plan (shown in Figure 3.46) supplied by McMunn & Yates, a building materials supplier from Dauphin, Manitoba. The Design Team believes that for its size, the bungalow plan has a lot of merit. There could be some separation of the bedroom from the living room. There is a centrally heated wood stove and room for wood storage. The "honey bucket" can be transported directly to the outisde. There is, however, inadequate storage and no vestibule entry. While there is a small eating area, the pass through opens the living room to the kitchen. There is also good compact utility room.

The McMunn & Yates 20'-0" x 24'-0" one and one-half storey plan (shown in Figure 3.47) is also a good tight layout for its size. The main floor gives one quite an open feeling. There is, however, lack of storage and no porch entry. The back door offers an entrance vestible. There is no return air from the upstairs. The roof framing system appears to be beyond the skill levels found in many communities. There also needs to be a much longer kitchen to meet the National Building Code or the kitchen must be redesigned.

3.8.2 Norseman Enterprises Ltd. Designs

The Norseman plans for basic housing to be built under the DIAND subsidy program. The drawings supplied provide excellent construction details which are required for Indian construction crews.

The bungalow house plan (See Figure 3.48) has options for the roof and exterior sidings. The bathroom is poorly located for the "honey bucket". There is no storage room but the drawings suggest that such a space can be provided in the basement. The larger four bedroom 24'-0" x 36'-0" bungalow is a good efficient plan (see Figure 3.49). If no basement is built, the design does not have an adequate amount of stoage. The bathroom unfortunately is located at the far end of the house, thus increasing plumbing costs. Finally, the doors enter directly into the living room.

The bi-level plan is a standard room layout for the size of bi-level proposed. There is, however, no place to locate a central wood heater.

The two storey six bedroom house is a very efficient plan (see Figure 3.50). The plan should incorporate some separate zoning to allow for a semi-private suite for seniors or a young couple living in the house.

3.8.3 Island Lake Tribal Council Designs

The Island Lake Tribal Council design its own houses and requests tenderers from suppliers to supply and construct the houses as per the design. A typical plan is the 24'-0" x 36'-0" 3 bedroom bungalow is shown in Figure 3.51. It has a very high circulation area. The plans designed by the Island Lake Tribal Council are generally open plans with open central spaces. Some of the plans do not have adequate separation between the bedrooms and living spaces. Bathrooms are generally in a poor location for transportation of the "honey bucket". Plumbing costs are higher for this design as well.

Figure 3.46

McMunn & Yates 24'-0" x 32'-0" Bungalow Plan

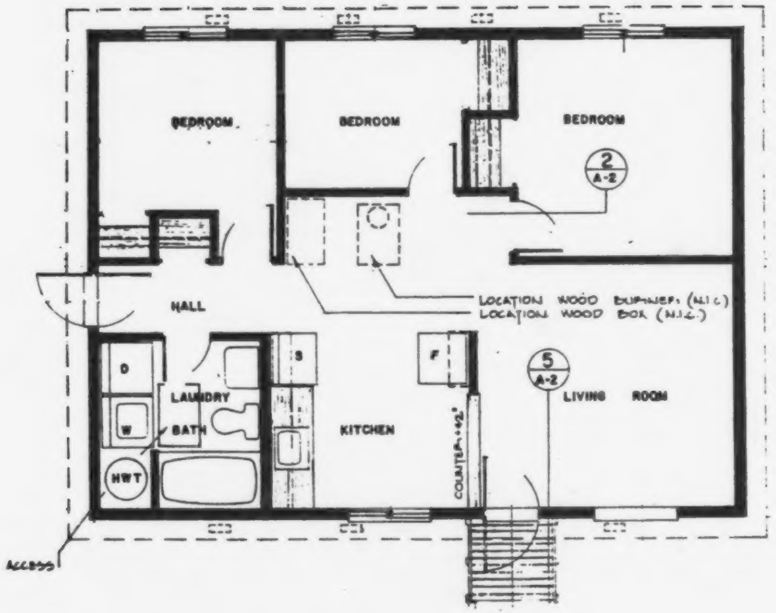

BEDROOM
BEDROOM
BEDROOM
2
A-2
HALL
LOCATION WOOD BURNER (N.I.C.)
LOCATION WOOD BOX (N.I.C.)
D
W
LAUNDRY
BATH
HWT
S
F
KITCHEN
COUNTER +42"
5
A-2
LIVING ROOM
ACCESS

Figure 3.47

McMunn & Yates 20'-0" x 24'-0" 1-1/2 Storey Plan

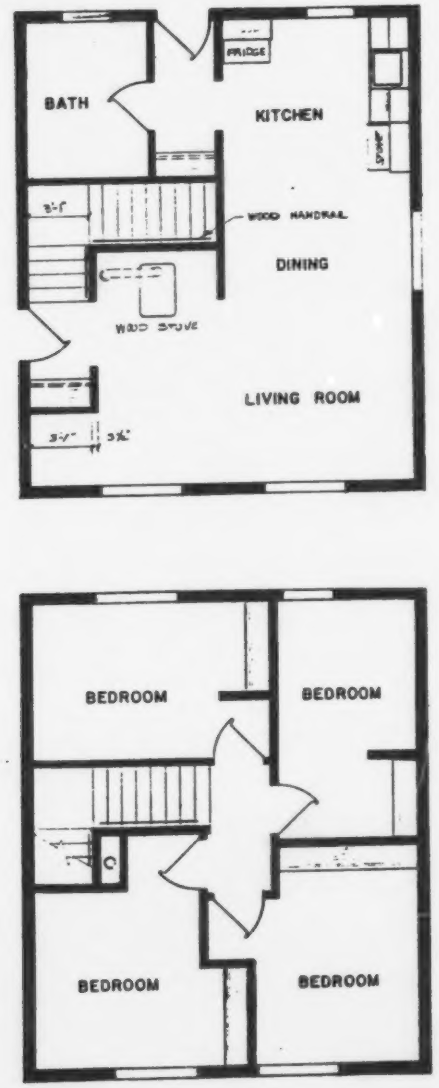

BATH
FRIDGE
KITCHEN
STOVE
3'-1"
WOOD HANDRAIL
DINING
WOOD STOVE
LIVING ROOM
3'-1"
3½"
BEDROOM
BEDROOM
BEDROOM
BEDROOM

Figure 3.48

Norseman Enterprises Ltd.

24'-0" x 30'-0" Bungalow Plan

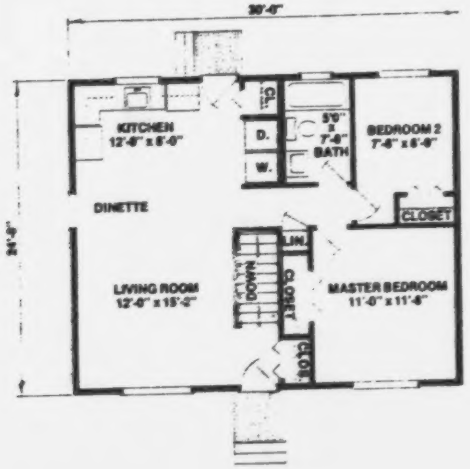

30'-0"
24'-0"
KITCHEN
12'-8" x 8'-0"
CL.
D.
W.
5'0" x 7'-8" BATH
BEDROOM 2
7'-8" x 8'-8"
DINETTE
CLOSET
LIN.
DOWN
CLOSET
LIVING ROOM
12'-0" x 15'-2"
MASTER BEDROOM
11'-0" x 11'-8"
CLOS.

Figure 3.49

Norseman Enterprises Ltd.

24'-0" x 36'-0" 4-Bedroom Bungalow Plan

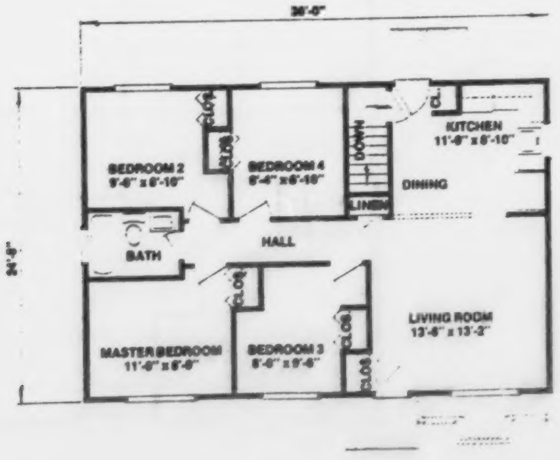

36'-0"
24'-0"
CLOS.
CLOS.
BEDROOM 2
9'-6" x 8'-10"
BEDROOM 4
8'-4" x 8'-10"
DOWN
CL.
KITCHEN
11'-6" x 8'-10"
DINING
LINEN
BATH
HALL
CLOS.
CLOS.
CLOS.
LIVING ROOM
13'-6" x 13'-2"
MASTER BEDROOM
11'-6" x 8'-6"
BEDROOM 3
8'-6" x 9'-6"

Figure 3.50

Norseman Enterprises Ltd.

6 Bedroom House

24'-0" x 32'-0" 2 Storey

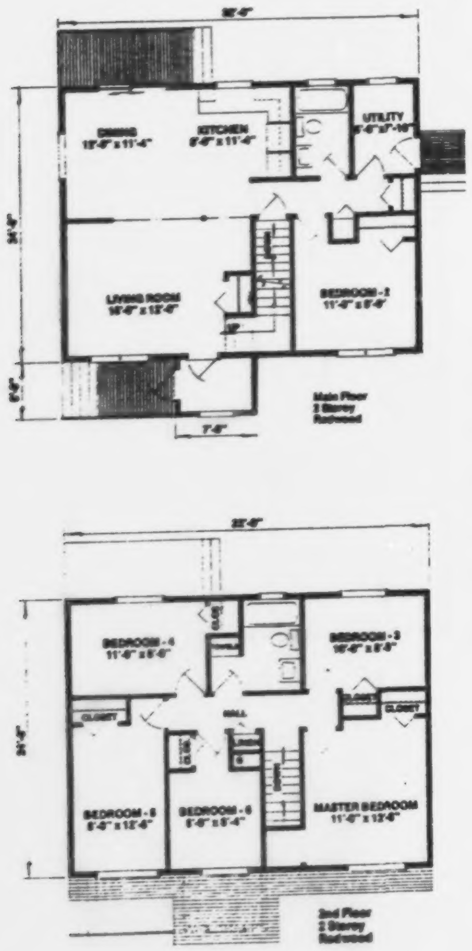
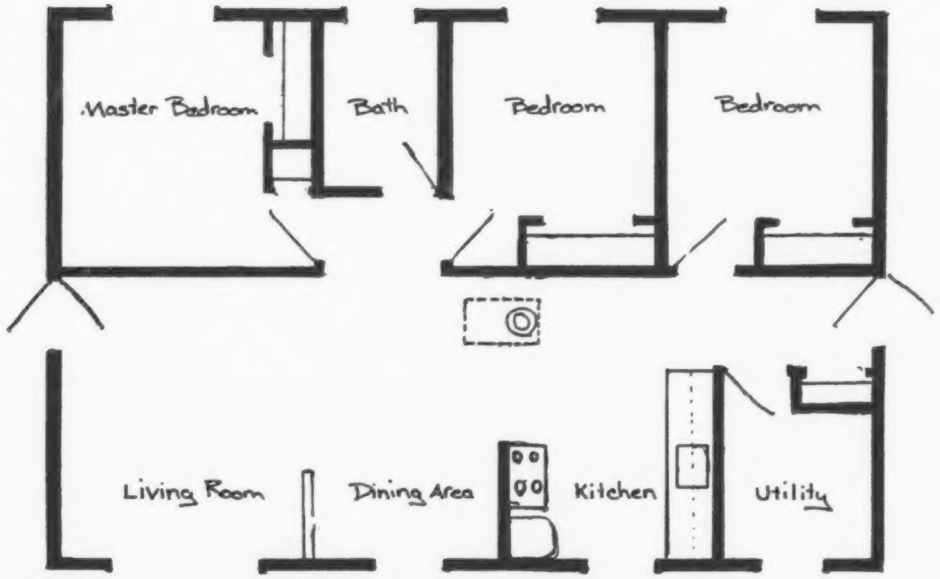

DINING
KITCHEN
UTILITY
LIVING ROOM
BEDROOM - 2
7'-6"
Main Floor
2 Storey
Redwood
BEDROOM - 4
BEDROOM - 3
CLOSET
HALL
CLOSET
CLOSET
BEDROOM - 5
BEDROOM - 6
MASTER BEDROOM
2nd Floor
2 Storey
Redwood

Figure 3.51
Island Lake Tribal Council
24'-0" x 36'-0" 3 Bedroom Bungalow Plan



3.9 Conclusions

The conclusions can be summarized as follows. The conclusions are structured by major section.

3.9.1 Province of Manitoba House Designs

- **MHRC House Designs (Figure 3.1 - 3.5)** - The Ready-to-Move (RTM) housing system is inappropriate in the remote communities. Yet some bands with restricted housing budgets have opted for purchasing of trailers, which can be considered a form of RTM housing. The problems can be summarized as follows. First, transportation costs are high, especially in remote communities. Second, there is no learning of building skills in the communities if the houses are built elsewhere. Third, Bands do not receive access to job training monies if RTM houses are built and the added value of these monies is not able to be built into the houses.

  The Province of Manitoba pioneered delivery of housing by native people and this practice should be continued and strengthened wherever possible.

  MHRC's widespread use of the R3 plan (which includes the cold porch) has devalued the design in the minds of many northerers. The standard set exterior features should be expanded so as to offer more of a variety of exteriors. The floor plans are as efficient as possible given the available budget. The design also has many positive features such as centralized heating system, low circulation space and a proper location of the washroom so as to permit the movement of the "honey bucket" to outisde without passing through the kitchen and other living aras.

  The roof design of the R2 unit was cheaper to build but was not as acceptable because the design was not familiar to northerners. This suggests that designs which are innovative, must be consistent with the expectations of northerners.

  Finally, the Design Team is not aware of any other major design problems that have been found in the MHRC houses.

- **J. Pass Designs (Figures 3.6 - 3.8)** - They are considered to be quite innovative. The design guidelines outlined by Kennedy/Smith that were followed by Pass are still generally valid today. The arch-rib design may be cheap to build but the design itself is questionable in todays situations. The one storey 24 x 28 bungalow plan is similar to what is used today. However, the Pass 2 storey house is a minimal but efficient plan. The advantage of the 2 storey design is that it is 18'-0" wide so that it can be built using a single span floor joist, it provides a separation of private and public areas and could provide possibilities for air movement between floor levels.

- **Krisno Nimpuno Designs (no Figures available)** - The European high technology panellized floor/wall system proposed by Nimpuno has little merit in the north for all the same problems found in the RTM Houses. Prefabricated northern components such as doors and windows, stairs and cabinets, require too many sophisticated skills that northerners do not have at this time. Local materials usage is also limited because of quality of available wood and the need to develop a good marketable product requires much R&D money, skilled people and time.

3.9.2 CMHC House Designs

- **Kennedy/Smith Designs (Figures 3.9 - 3.12)** - These designs developed in 1967 would be considered to be quite basic and unsophisticated by Indian people today. However, the architectural design guidelines developed by Kennedy/Smith are still valid.

- **Crofter House Design (Figures 3.13 - 3.21)** - The Crofter House was designed for areas where full service is available. In areas where water and sewage disposal are not avaiable, the floor plans indicate that the "honey bucket" must be carried through the main living areas of the house in order to reach the outside. These house designs also depend upon a mechanical heating and ventilation system. The heating distribution system has a portion of the heated furnace air dumpted into a wood plenum under the floor. This may be a poor design practice which may even contravene building codes.

3.9.3 DIAND House Designs

- **The ID Design Series (Figures 3.22 - 3.24)** - The ID1 house is a basic house meant for singles or seniors. It and the ID3 house designs would be considered unsophisticated by Indian people today. The designs have no private space. The exterior storage sheds could be better linked to the house itself. The ID7 house has too many wings to it and this could create potential foundation problems. It is also a very basic house plan which has little storage or private space and the "honey bucket" has to be carried through the living/dining areas of the house.

- **The RD House Series (Figures 3.25 - 3.26)** - The RD6 and RD12 houses have the back entry through the kitchen which is appropriate. In remote areas, houses with no mechanical heating systems means that the heat distribution will be very poor. There is a lack of openess on both plans because the living areas are separated from other parts of the house.

- **B. Chill House Designs (Figures 3.27 - 3.28)** - The designs are quite expensive and sophisticated, and are meant mainly for high arctic conditions. The layout of the rooms do not encourage a feeling of openess. However, the below grade entry is a good idea.

3.9.4 Quebec/Naskapi House Designs

- **Quebec Indian House Designs (Figures 3.28 - 3.30)** - These houses were designed to maximize the use of local materials and to explore the use of solar heating. The designs require the use of "appropriate technology" and as such, are very labour intensive. They require a large labour input and the designers found that few Indian families were willing to make this labour commitment. The same comments for the Cote Nord houses can be made for the Pte Blue and Mistassini designs.

- **Naskapi House Design (Figures 3.31 - 3.33)** - This is a more conventional bungalow house design. The main features of the house relate to the energy efficient building envelope rather than the interior layout.

3.9.5 Arctic Housing Designs

- **J. Ross Design (Figure 3.34)** - This design is a split level design with no basement. The entry system is from below which is more standard for arctic housing conditions. The heating system requires a fan to move the heat down to reduce stratification. The "honey bucket" must be carried down three floors. The layout of the house is reasonable but split level designs are generally more expensive than bi-level or bungalow designs and are not as acceptable under the Modest Housing guidelines of CMHC.

- **Hia Toh Lim House Design (Figure 3.35)** - This house is designed more for arctic conditions for Inuit rather Indian needs. The design includes a lot of built in furniture which may be desirable as people do not have the money to purchase furniture. The house has an innovative sleeping system based upon sleeping rooms with multilevel pallets or beds on moveable rails. While the house design has a flexible usage of interior space, it would probably not meet the needs of most Indian people. Finally, the passive solar thermal wall is now considered inappropriate in most locations.

- **Other Arctic House Designs (Figures 3.36 - 3.44)** - The Allen/Drerup/White House Designs (Figure 3.36) - The super insulated houses are innovative but too expensive. The S. Fancott House Design (Figure 3.37) - the design has a lot of circulation space on the main floor. The wall system is too complicated. The house needs access to a full sewer and water system and requires an active heating system. The Shelter Corporation Igloo House Design (Figure 3.38) - the house is in the shape of an igloo and as such would be inappropriate for Indian people. Finally, the Design Team also reviewed a series of reports and conference proceedings on Arctic housing.

3.9.6 International Housing Designs

- Little could be found on international housing designs.

3.9.7 Log Housing Designs

- Log House Designs (Figure 3.45) should not be considered as it cannot be made energy efficient. Many remote communities do not have trees of adequate size for log housing. Previous experiments show that the stackwall technology, while innovative, is impractical and too expensive.

3.9.8 Designs Currently used in Northern Manitoba

- The designs provided by Manitoba Building suppliers and the Island Lake Tribal Council (Figures 3.46 - 3.51) are quite good because they are very efficient and are targetted to the DIAND and CMHC housing programs. The major problems appear to be a lack of privacy and the poor location of the bathroom. The "honey bucket" must be carried through the main living area and the plumbing costs are higher than necessary.

3.9.9 General Conclusions from the Architectural Review

The conclusions can be summarized as follows:

- **There will not be "one ideal" solution to remote housing,** but a combination of several designs to meet different needs and tastes within budget and administrative contraints.
- **To date, it would appear that the majority of houses built in the north are inadequately constructed, and not designed for the north.**
- **The 3-bedroom floor plans common to most designs do not meet the requirements in all situations.** There may be a need for a variety of house sizes. By building mostly 3 bedroom bungalows, young and old people do not have the option of moving out of the "family" house if it is felt to be desirable by the Bands.
- **The Bands should consider building of some small houses in the communities** reduce the number of people in some houses and allow extra funds to build some even larger homes to accomodate adequately extra large families.
- **The $35 - $45,000 available for a DIAND house appears to be inadequate in providing the family with what is desirable for the** This **north** (due to high cost of materials and transportation). high cost could be lessened somewhat if the potential homeowner would consider providing some of his/her own labour into the construction of the house to help keep costs down or put more into materials. Normally this could be difficult because on most reserves as housing is owned communally. Another funding source that many Bands use is the Welfare Operational Programe that converts welfare into wages. The Bands also use the various employment grants that are available. This additional money is critical to the provision of better quality housing.
- **Since northern residents are indoors for considerably longer periods during the winter than are their southern counterparts, room sizes within northern houses should be correspondingly larger** to reflect the increased usage of space. This is economically unfeasible at present in that larger houses would cost more than current budgeting allows. A compromise between house size and cost has to be met.
- To help cut costs and to meet traditional lifestyles, construction practices within Indian communities often differs from requirements specified within residential building standards.[1] This can also be attributed to local ability, (i.e., the standards may be too complicated in some sections to be easily understood and implemented).

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[1] Such standards include:
a) the National Building Code of Canada.
b) Northern Residential Standards for Energy Efficient Housing, Draft 2, June 1983.
c) Design Guidelines and Technology for Northern Housing Construction, B. Chill, April, 1983.

- **Problems with northern housing dating back to the 1967 Kennedy/Smith report are still major concerns today.** Many of the cultural and economic factors that were being addressed in the Kennedy/Smith report have changed to the point where most Indian people are ready for and are demanding more sophisticated housing. However, the basic architectural and engineering design requirements outlined in the study are still valid and must be answered in order to provide complete and satisfactory housing in the north.

- **The main features or problems that must be addressed by the Design Team are:**

  - protected entrances/cold drafts at entrance.
  - poor heat distribution.
  - condensation problems.
  - ventilation.
  - overcrowding as well as public versus private space.
  - cold floors.
  - lack of storage space.
  - water supply.
  - waste disposal.

  Some of these design considerations will lead to trade-offs and compromises in the internal room layout, such as having the sleeping areas (bedrooms) separated from the living areas (kitchen, dining, living rooms) often means in one storey designs that heat circulation is a problem.

  The designs must also be prepared within the financial and budgetary constraints composed by the DIAND and CMHC housing programs.

- **To date, about the only design provided to Indian people has been various sized bungalows** (with or without basements). It appears that all variations of the bungalow floor plan possible have been made available. Other types of housing (1-1/2, 2 storey, etc.) which may be more cost efficient to build, and could solve some of the other problems, should be considered.

- **It is almost impossible to separate the architectural design (layout, size, type) of the house from the engineering aspects when designing northern houses** because the problems and solutions are very much more interrelated and interdependent upon one another. For example, the architectural designer in the "south" may wish to design in features that may require a simple change in the foundation, but in the "north" this becomes an unworkable problem or a grossly expensive problem for the engineer to solve.

3.9.10 Summary of Design Considerations

Designs prepared in this exercise by the Design Team should encompass such factors as:

- providing the opportunity for air circulation within the house to ensure adequate heat distribution,

- locating the bathroom close to the exit for optimum sanitary conditions in cases where the "honey bucket" system is used,

- trying to allow for a feeling of spaciousness by limiting use of partitions and possibly including high ceilings,

- incorporating a vestibule in the entrance,

- making ventilation systems as quiet and as easy to operate as possible,

- using fans that have long life spans (10-12 years) if fans are necessary,

- exploring the use of built-in furniture to help improve the living environment.

IV ANALYSIS OF THE ENGINEERING DESIGN CONSIDERATIONS FOR NORTHERN HOUSING

4.1 Introduction

This section of the report has been prepared to offer the reader a background on the engineering aspects of housing design and construction practices within the Study Communities. It is intended to summarize "how" houses are constructed and to examine the problems which are occurring. A particular emphasis is placed on those problems which affect the energy performance of the houses.

Many of the problems of northern housing are well known and recognized:

- Unsafe and inefficent heating systems consume excessive amounts of fuel and are responsible for high rates of fire loss and personal injury.
- Poor foundations which cause major structural problems due to shifting and settlement.
- Building materials and products which lack the durability needed to withstand the rigorous northern environment.
- Doors and windows which break down, freeze up and are in a constant need of repair.
- Drafty, uncomfortable houses which are too hot near the stove and too cold in the end rooms.
- Moisture-damaged ceilings, walls and floors.
- Inadequate water supply and waste disposal systems.

To address these and other problems, the typical northern house found in the Study Communities was examined in detail. The results of this examination are presented in this Chapter. This information, when combined with the architectural considerations described in Chapter III, forms the background for the final house designs.

4.1.1 Objectives

The specific objectives of the engineering component of the Background Review are to:

1) Review current design and construction practices in the Study Communities with a particular emphasis on identifying energy-related problem areas and opportunities,
2) Identify possible solutions to these problems recognizing the practical and economic constraints of housing delivery in the north, and
3) Review relevant codes, standards, and other documents pertaining to house construction in the communities.

The first objective proved a challenging excercise because of the general absence of detailed information on current housing stock and construction practices within the 12 Study Communities. In most cases, little printed information was available beyond general demographic, housing and energy use statistics. Although some recent reports on housing in selected communities were found, most provided only broad descriptions with minimal detail. The sources of information which proved most useful were personal contacts with various Band and Tribal Council housing officials, representatives of the Dept. of Indian and Northern Development (DIAND) and of Manitoba Housing, commercial builders, building materials suppliers and house designers serving the Study Communities as well as the personal experiences of Design Team members who had visited the majority of the communities over the past six years.

The second objective drew upon all the collected data and information to identify possible solutions or at least alternatives which were judged to be worthy of further consideration.

The last objective consisted of a literature study of the appropriate documents. Particular emphasis was placed on documents which might provide useful ideas for eventual inclusion for the design stages.

4.1.2 Design Philosophy

Over the years a wide range of construction techniques, building systems and products have been considered or suggested as answers to "northern housing problems". In some cases, these have constituted relatively simple modifications to existing practices - such as the move to

2 x 6 construction to allow increased insulation levels. In other instances, radical departures from conventional building practices have been promoted. New products ranging from improved heating systems to composting toilets to quadruple glazed windows have also been suggested.

In the Background Review of this project, the Design Team studied a large number of these concepts, both on the basis of their own experiences and those of others with northern housing backgrounds. Considerable thought was then given to the development of a design philosophy upon which final house plans could be based. Considering the very real and practical problems of the north (limited housing budgets, severe climatic conditions, high occupancy levels, rugged lifestyles, distance from suppliers, the varying availability of trained personnel) it was concluded that housing problems were best addressed by relying upon established and proven design practices, and not radical departures from conventional techniques and products. Ultimately, if adequate funds became available and proper development programs are created to explore major changes, then they could be pursued. However at this time the conditions needed to support these efforts do not exist. Any designs which are intended for general application within the next few years must acknowledge and respect the problems and limitations of building in the north. The reader will notice an emphasis on basic, solid design and construction practices rather than major leaps in technology. Practical, not ideal alternatives are stressed.

At the same time, we have attempted to identify for future investigation those areas where major changes are warranted, even though they cannot necessarily be pursued within this project (considering budgets and time).

Even though each house component and system has been reviewed separately, it has also been recognized that good design requires an integrated approach - integration with the other building elements as well as the social framework of the people who will live in the houses. With this approach in mind, the problems of energy efficiency in northern housing have been investigated. As a result, issues and problems which might not initially appear to be "energy-related" have been addressed. For example, the problem of foundation heat loss cannot be properly discussed without considering the problem of foundation failures. Minimizing ceiling heat loss cannot be adequately considered without identifying ceiling finish materials which possess the durability and function needed in northern housing. In a more general analysis of energy consumption, one could even consider the extra energy costs (in materials, production, transportation and labour) required to replace housing which fails at a faster rate than its southern counterpart and thus requires earlier replacement. Thus it is the Design Team's belief that the durability of the structure and its systems must be treated as an integral component of energy-efficient housing.

4.1.3 Residential Energy Use in the Study Communities

A summary of the residential energy use characteristics in the 12 Study Communities is shown in Figure 4.1. All data is for 1982, the most recent year for which information was available. Also included are estimates of the population and housing statistics for each community.

The electrical consumption data is considered to be very accurate since it comes from a single set of metered sources. However the wood consumption data should be treated as only an estimate since almost all wood collection is by individual homeowners for which there are no firm records. Consumption of fuel oil and propane for residential use can for all practical purposes be ignored.

Also note that the data shown for Lac Brochet, Pukatawagan, and Tadoule Lake is known to be incomplete. The housing statistics were based on the number of metered users connected to Manitoba Hydro service. However in each of these communities there were houses occupied and heated but not connected to Hydro.

FIGURE 4.1

ENERGY USE IN THE STUDY COMMUNITIES

COMMUNITY	POPULATION	NUMBER OF HOUSES	POP. DENSITY (PEOPLE/HOUSE)	ELECTRICITY (MWh)^1	ELECTRICITY (GJ)^2	APPROXIMATE WOOD USE (CORDS)	APPROXIMATE WOOD USE (GJ)	APPROXIMATE TOTAL ENERGY USE (GJ)
BROCHET	640	69	9.3	306	4,644	1,152	18,202	22,846
GARDEN HILL	1,800	265	6.8	1,438	20,237	4,028	63,642	83,879
GOD'S LAKE NARROWS	1,250	150	8.3	761	11,327	2,475	39,105	50,432
GOD'S RIVER	250	39	6.4	180	3,398	651	10,286	13,684
LAC BROCHET	380	$(21^+)^3$		50	968	$(365^+)^3$	$(5,767^+)^3$	$(6,735^+)^3$
OXFORD HOUSE	1,250	177	7.1	760	10,430	2,885	45,583	56,013
PUKATAWAGAN	1,100	$(85^+)^3$		303	5,983	$(1,318')^3$	$(20,824^+)^3$	$(26,807^+)^3$
RED SUCKER LAKE	425	53	8.0	275	4,093	875	13,825	17,918
ST. THERESA PT.	1,450	191	7.6	956	14,979	2,903	45,867	60,846
SHAMATTAWA	680	67	10.1	248	4,209	1,206	19,055	23,264
TADOULE LAKE	215	$(30^+)^3$		60	1,161	$(483^+)^3$	$(7,631^+)^3$	$(8,792^+)^3$
WAASAGOMACH	730	89	8.2	427	6,506	1,353	21,377	27,883
TOTAL	$10,170^+$	$1,236^+$	7.7^4	5,764	87,935	$19,694^+$	$311,164^+$	$399,099^+$

Notes

1. Based on gross energy content of diesel fuel.
2. Net electrical energy delivered to houses.
3. Incomplete data, true values are higher than those shown.
4. Exclusive of data for Lac Brochet, Pakatawagan, and Tadoule Lake.
5. All data from Reference from "Energy Profiles for Manitoba Remote Communities" by UNIES Ltd., January, 1983.
6. MWh: megawatt hours
   GJ : gigajoules

4.2 Review of Current Design and Construction Practices

On the following pages each of the major components of a typical northern house (such as foundations, windows, roofs, etc.) is examined, reviewed and discussed according to the following four-point format:

1. Characteristics of Good Design
   - Reviews the major features required for an energy-efficient and practical design suitable for northern applications.
2. Existing Conditions
   - Describes the current housing conditions in the Study Communities.
3. Problems
   - Specific problems identified for each component are described.
4. Possible Alternatives
   - Better or more appropriate alternatives are described and evaluated.

The reader will notice a degree of repitition within each discussion for example durability is constantly stressed as a problem. Although this may seem somewhat tedious, such repitition can be regarded as an indication of how widespread some problems are.

Housing delivery within the Study Communities is the responsibility of the individual Bands. Each has a housing officer whose duty it is to oversee all aspects of the actual construction from initial design to final acceptance by the family who will occupy the house. Foremen, tradesmen and labourers are hired at the beginning of the summer construction season. In most communities, carpentry and general construction skills are locally available while more specialized trades, such as electricians, often must be imported.

Building materials are purchased by the individual Bands from a number of different suppliers who in many cases also provide design services. In most cases the supplier is responsible for materials delivery to the community. The majority of supplies are brought in over winter roads although in a few very remote communities they must all be transported by air. House designs, as described in Chapter III have originated from a variety of sources. In some communities, a new house will be designed in close consultation with the family who will occupy it so that their exact requirements can be met. In other cases, relatively standard "off-the-shelf" designs are used.

4.3 Foundations

4.3.1 Characteristics of Good Design

A house's foundation is the structural platform which attaches it to the ground. Variations in soil conditions, construction styles and the costs of materials between communities make it impossible to identify or design a single "best" foundation for northern housing. However, a good foundation design will consider each of these factors. There are major variations in each of these factors in the communities reviewed in this study. Soil conditions vary from bedrock to well drained sand or gravel soils to muskeg and from intermittent permafrost to non-permafrost areas. House sizes range from the compact 20' x 24' (6.1 x 7.3m) bungalows in Tadoule to the more expansive 24' x 40' (7.3 x 12.2m) bungalows constructed in some of the older communities. In areas with good aggregate supplies and winter roads, concrete is a feasible building material. In places without road access or suitable aggregate, the cost of concrete can be formidable.

Characteristics of a good foundation design are:

1. Level - The foundation should provide a level surface on which to construct the house. This makes it easy to build the house square and straight, ensuring that seams and joints can be tight.
2. Stability - The foundation should remain level over time. Unstable foundations which heave or settle can cause serious structural damage to the house.
3. Durability - Because of its position under the house, a foundation cannot be easily repaired or replaced. Over its life it will be subjected to significant and potentially varying loads. For this reason the foundation must be strong and durable, with a design life at least as long as useful life of the house. In fact a good foundation will help preserve the structural integrity of the house, thus extending its useful life.
4. Dryness - The ground inside the foundation perimeter should be dry. Drainage around the foundation should direct surface water away

from it. A polyethylene ground sheet will prevent ground water from evaporating into the crawl space.

5. Simplicity of Construction - The lack of equipment and some trade skills in the far north dictates that foundation designs for northern housing be simple to construct and not require specialized tools or equipment.
6. Lightweight - The cost of freight into many communities adds severe cost penalties to heavy construction materials. Where this is the case, the foundation design must favour lightweight materials.

4.3.2 Existing Conditions

House foundations in the MKO communities vary from site to site and with the age of the house. Basements, which are standard in southern Manitoba are virtually non-existent in the north. Historically the standard foundations have been post on pad or stub walls on a concrete spread footing on bedrock. Houses are usually built with three floor beams, one along each long outside wall and a central beam. The central beam is supported mid span by posts on pads. Traditionally the house floor rather the skirting around the crawl space was insulated. As a result the soil under the foundation froze in the winter. In non-permafrost areas this is highly undesirable as it can result in differential frost heave in the foundation (i.e. the outer walls move relative to the centre of the house). Unless regular adjustments are made to the central beam support posts this movement is transferred into the structure, causing floors to heave or fall away from inside walls, and in extreme cases causing outside walls to split. The common effects of differential movement are sloping floors, doors which stick, windows which do not close squarely in their frames and cracks in wall finishes or wall joints opening up. Many of these problems can be overcome if the foundations are routinely leveled but generally this is not done.

Recently some improvements have been introduced in foundation design in the north. There has been a shift towards insulating the perimeter skirting or foundation rather than the house floor in non-permafrost areas. This has the effect of reducing the frequency of frost heave induced damage. In areas with well drained sand and gravel soils such as Tadoule Lake and Brochet, preserved wood foundations are being used. These are light weight, reducing freight related costs and are easy to construct and insulate. They can rest on either a preserved wood bearing plate, a concrete spread footing or bedrock.

4.3.2.1 Soil and Foundation Conditions In the Study Communities

DIAND and the Province of Manitoba Water Resources Branch were contacted in an effort to gather relevant data on ground conditions in the Study Communities. The following briefly summarizes the information obtained on surficial geology.

Tadoule Lake-

Information Sources: Band officers, materials supplier (McMunn & Yates), community planner (James Thomas of Hilderman Witty) and personal observation.

Conditions: Primarily well drained sands and gravels in building areas. Low lying areas have an organic overburden, and frequently water tables near the ground surface making them unsuitable building sites. The well drained areas are highly suitable for preserved wood or concrete spread footings, provided erosion of soils around the footing can be controlled.

Pukatawagan -

Information Sources: "Gravel Search - Airphoto Study for Granular Material Prospects for Pukatawagan Reserve", Klohn Lenoff Consultants Ltd.; February 1978.

Conditions: Frequent outcrops of Precambrian bedrock surrounded by extensive deposits of wet clays and silts. The overlaying peatlands are a mixture of marshy areas and plateaus. Ideally foundations will rest upon bedrock and may be of the perimeter or pier type. Generally, concrete footings are favoured over preserved wood.

Brochet -

Information Source: "Terrain Analysis and Land Use Capability Evaluation for Brochet Reserve", W.L. Wardrop & Associates Ltd.;

March 1979; "Manitoba Northlands - Community Planning Geotechnial Land-Use Study, Brochet", Province of Manitoba Water Resources Division, August 1976.

Conditions: The major portion of the Indian settlement is situated on a sand and gravel esker deposit. There are also some bedrock areas within the community. Both landforms are well drained and thus have good foundation characteristics.

Shamatawa -

Information Source: "Terraine Analysis and Land Use Capability Evaluation for Shamatawa Reserve", W.L. Wardrop & Associates Ltd.; March 1979.

Conditions: The geology around Shamatawa consists of sedimentary bedrock overlain with 30 to 40 feet (9.1 to 12.2 m) of overburden. There is intermittent permafrost in the area. Existing house sites are generally well drained except in flat areas with clayey surficial materials. The normal foundation in older houses consists of a beam set on a concrete spread footing, 2 to 3 feet (0.6 to 0.9 m) below grade. Newer houses use pressure treated wood spread footing 2 feet (0.6 m) wide, 8" (0.2 m) deep. Both have proven satisfactory. Differential settlement has not been a problem.

Red Sucker Lake -

Information Source: "Red Sucker Lake Community Plan", Rieber-Kremers & Associates Ltd., June 1978; "Manitoba Northlands-Community Planning Geotechnical Land-Use Study-Red Sucker Lake", Province of Manitoba, Water Resources Division, November 1976.

Conditions: Thin layers of sand or silt and clay over massive Precambrian bedrock. The overburden ranges from nothing (i.e. open rock) to 5 feet (1.5 m) deep. Surface peat is common, especially where the water table is high. Overburden is usually deepest in low lying areas. Houses should be sited in the higher, better drained areas. Foundations should rest on bedrock.

Oxford House -

Information Source: "Soil and Foundation Investigation for the Proposed Houses at Oxford House, Manitoba", M. Block & Associates Ltd., September 5, 1984; "Manitoba Northlands - Community Planning Geotechnical Land-Use Study, Oxford House", Province of Manitoba Water Resources Division, July 1977.

Conditions: Layers of sand, varied clays, silts and gravels overlaying undulating bedrock. Oxford house is in a region of intermittent permafrost. Houses should not be sited on permafrost pockets. Frost heaving effects are potentially severe in some of the lower lying areas. The information source recommends either a concrete raft slab placed on compacted granular fill (i.e. a structural slab on a compacted gravel base) or a perimeter foundation resting on a spread footing four feet below grade. Safe bearing pressures are 1000 pounds per square foot. If the second foundation type is used, sulphate resistant cement should be used for concrete footings.

Gods Lake Narrows -

Information Source: "Soil and Foundation Investigation for the Proposed Houses at Gods Lake Narrows", M. Block & Associates Ltd., September 5, 1984; "Manitoba Northlands - Community Planning Geotechnical Land-Use Study, Gods Lake Narrows", Province of Manitoba Water Resources Division, July 1976.

Conditions: The area has layers of silty clay and glacial till over undulating bedrock. The bedrock varies from 2' (0.6 m) to 4'4" (1.3 m) below grade. Houses can be founded on a spread footing at or near the 5 foot (1.5 m) depth. Safe soil bearing pressures at this depth are 3000 pounds per square foot. However due to the possibility of heaving caused by potential swelling of the clay and frost action in the silt, it is generally more practical to transfer building loads to the shallow bedrock by means of cast-in-place concrete or wooden piling emplaced down to the bedrock.

Gods River -

Information Source: "Soil and Foundation Investigation for the Proposed Houses at Gods River, Manitoba", M. Block & Associates Ltd., September 5, 1984.

Conditions: The soils in the area consist of layers of sands, clays and gravels underlain by a glacial till. Muskeg of 1 to 1½ feet (0.3 to 0.5 m) covers most areas. Bedrock undulates at depths greater than 4 feet (1.2 m) below grade. The water table is near the surface in some areas. The most suitable type of foundation is dependent on the depth of the water table. Where the water table is deep, the house can be founded on concrete spread footings designed to a soil bearing capacity of 1500 pounds per square foot. If the water table is within 2 feet (0.6 m) of the surface, the muskeg must be removed and replaced with compacted granular fill onto which a structural slab (raft concrete slab) is poured.

Garden Hill -

Information Source: "Manitoba Northlands - Community Planning Geotechnical Land Use Study, Garden Hill", Province of Manitoba Water Resources Division, May 1978.

Conditions: The bedrock surface is irregular and the overburden is relatively shallow. Footings should be carried down to bedrock to avoid differential movement. Larger buildings should be placed on bedrock or on piles down to bedrock. The effect of seasonal frost on shallow foundations is generally considered to be low. Permafrost may be encountered in isolated areas with a northern exposure and where the relief is relatively high. Special precautions will have to be taken for foundations placed on the permafrost or because of the isolated occurrences of the permafrost, it may be possible to clear the area of all vegetation and organic soil one or two years prior to the development of the area in order for the permafrost to thaw.

St. Theresa -

Information Source: "Manitoba Northlands Community Planning Geotechnical Land Use Study, St. Theresa Point (St. Mary Island - Airstrip)", Province of Manitoba Water Resources Division, June 1977; Personal communication with knowledgeable persons.

Conditions: Bedrock overburdened with shallow clay deposits. Clay subgrade has a moderate potential for volume change and is susceptible to frost heave if moisture is available in the freezing zone. Housing should therefore be founded on gradebeams or piers resting on bedrock.

Waasagomach -

Information Source: "Manitoba Northlands - Community Planning Geotechnical Engineering Services, Community of Waasagomach Airstrip Relocation Geotechnical Report", Province of Manitoba Water Resources Division, April 1978; Personal communications with knowledgeable sources.

Conditions: Precambrian bedrock at or near the surface overburden with silts and clays. Clays have a low to moderate potential for volume change and are also susceptible to frost action if moisture is available to the freezing zone. Foundations consisting of concrete grade beams or piers resting on bedrock are recommended.

4.3.3 Problems

1. Settling or Heaving - The single most significant problem that can result from a poor foundation design is instability or movement in the foundation. Differential movement, or movement of one part of the foundation relative to other parts is particularly serious. This happens where the soils under a foundation settle under load, swell or shrink due to moisture changes, heave from frost action or where heat losses to the foundation thaw and destabilize permafrost. These types of problems are regional and not of significance at all building locations. They are not of concern for example in areas where

houses are founded on bedrock or where building sites are on well drained sand or gravel soils.

2. Soil Erosion around Footings - In some locations, with fine or loose soils, soil erosion around the foundation can present a problem. Examples of this problem were observed in Tadoule Lake, especially where buildings were on sloped ground. A combination of pedestrian traffic and water drainage near a foundation on a sandy slope erodes the soil. If the footing is shallow and the slope fairly steep, as is the case for at least one structure in Tadoule Lake, this erosion can undermine the footing.

   The drainage problems can result from interference with natural surface flow or from directing roof water along the footing. Eventually the erosion may be extensive enough to cause a major settlement or failure in the foundation.

3. Cost and Quality of Concrete - Concrete has traditionally been the preferred material for foundation in Canada, and is still widely used in remote communities. Its cost has been high in many cases. There are several reasons for this. First, transportation costs for cement can be significant, especially where surface transport cannot be used. Secondly, the aggregate needed for the concrete may be difficult to clean or transport, making its use costly. Finally, the deficiency of specialized concrete mixing and handling equipment means that it is labour intensive to make and hence expensive.

   The quality of concrete in house foundations is not generally a concern. The presence of silts, clays and organic material (i.e. peat, levels, wood, etc.) can however severely reduce the strength and durability of concrete. Furthermore, damp storage conditions can cause cement to solidify in the bag. Although it can be broken up and used to make concrete afterwards, the concrete will have a much lower strength than would otherwise be expected.

4. Condensation in Crawl Spaces - Damp crawl spaces under houses cause moisture induced decay of wood construction materials and may aggravate humidity problems inside the living space. Moisture in the crawl space may be the result of a high water table, it may come from surface drainage which passes under the house or it may be caused by roof water or washwater from the house which finds its way into the crawlspace.

   As stated above, this may generate an immediate problem in the form of increased humidity levels in the living space, and a long term problem by accelerating decay in wooden foundation materials. The later problem was reported by a number of sources. In crawl spaces, moisture condensed and froze in wood members near the cold outside walls in the winter. The quantity of moisture was sufficient to saturate the wood and in some cases yield free water in the wood.

4.3.4 Possible Alternatives

The solutions to foundation problems are dependant on, among other things, the ground conditions at the building site. As such there is often not a single "best" solution to a problem type, although there are best solutions for a problem type at a specific location. The solutions discussed in this section must be considered only in the context of the soil conditions for which they are recommended.

Settling and Heaving

1. Eliminate Central Beam Supports - In areas where differential movement in the supports under the central beam is a problem, one solution is to develope a floor system which eliminates the mid span supports under the central beam or eliminates the central beam entirely. In order to eliminate the mid span supports under the central beam, a beam capable of much greater loads must be incorporated into the house design. Beams could be all metal or could be specially constructed wood and metal beams or trusses. The problems with this approach are:
   1. The first cost of the beam will be much higher than the coventional site built beam with its supports.

    2. The length of the beam may restrict its use to those communities with surface transportation into the community or to house lengths not exceeding 24 feet (7.3 m).
    3. The weight of the beam (possibly over 1.5 tons (1.4 tonnes)) may present an obstical to positioning it on the foundation.
    4. The depth of wood beams or trusses means that crawl spaces must be deeper or foundation walls higher and that the beam will, in most cases separate the crawl space into two compartments. Suitable wood beams or trusses would be several feet deep.
    5. Long beams tend to give bouncy or springy floors. In some cases walls pull away from the floors or ceiling because of this movement.

2. Clear Span Floor Trusses - Given the problems with a full span, unsupported central beam, a second alternative, namely eliminating the central beam completely by going to pre-fabricated floor trusses has appeal. These trusses are commercially available and would have an incremental materials cost of $500 to $1,000 per house (depending on house size) over the central beam approach. There should be savings in terms of time and labour spent constructing the floor system.
3. Construct Structural Slab - Structural slabs or raft foundations are reinforced concrete slabs designed not to crack, but rather to move as a unit in the event of settling or heaving ground. They are made out of large amounts of good quality concrete. This makes them cotly in all instances and infeasible in many. They are often used in permafrost areas.
4. Insulate Foundation from Freezing - Frost heaving can be eliminated by preventing the soils around or under the foundation from freezing. This is done by insulating around the outside perimeter of the foundation and maintaining the foundation perimeter above freezing temperatures. In a crawl space this is most easily achieved by heavily insulating the foundation walls, and eliminating insulation under the house floor. In the past this approach has been rejected by the people in the communities because it has resulted in cold floors. With the increased levels and quality of insulation now being used in northern housing, this problem has been largely overcome. **THIS APPROACH MUST NOT BE USED FOR HOUSES BUILT ON PERMAFROST.**
5. Use Deeper Footings - In many areas, soil conditions become more stable as depth increases. That is to say, differential movements decrease and allowable soil bearing pressures increase with depth. Where this is the case, settling and heaving can be reduced by using deeper footings. Soil tests are needed to determine if this is the case. In other areas, especially those with high water tables, foundation conditions may deteriorate at lower levels.
6. Increase Footing Bearing Area - Where settlement of foundations is a problem because of a low soil bearing capacity, the standard solution is to increase the bearing area of the footing. This is done when other solutions such as going to a deeper, more stable ground conditions are not viable.

Erosion around Footings

1. Avoid Building in Erosion Prone Areas - In areas with easily errodable soils, builders should avoid building sites on the side of hills or along natural drainage routes. It is these types of sites at which erosion will be most severe.
2. Protect Soil around Footings - A crib can be built around a foundation, to hold the soils near the foundation in place. The crib, located a few feet out from the foundation should be designed to divert water and pedestrian traffic away from the footings while retaining natural ground covers at the footing.
   If water erosion is the problem, diversions can be constructed to

drain surface water away from the footings. Eaves troughs should be provided on the house, and rainwater leaders should be located not to cause erosion at the footings.

Cost and Quality of Concrete

1. Use Alternate Materials - There has been a shift to preserved wood foundations in many remote communities. The suitability of preserved wood footings is dependant on local conditions, but locations with well drained soils with reasonable soil bearing capacities (above 2000 pounds per square foot (psf)) lend themselves well to wood footings.

Moisture in Crawl Space

1. Vapour barrier on Crawl Space Floor - Building plans for new northern housing now typically show 6 mil polyethylene on the ground surface under a house, covered with a protective layer of sand. This will significantly reduce ground source moisture in the crawl space.
2. Ventilate Crawl Space - Increasing the ventilation rate in the crawl space can reduce the humidity level close to that of the outdoor air. This can be done by providing vents in the skirting around the crawl space or by installing an exhaust fan in the crawl space. Where vents are used, they should be opened during warmer weather to dry the crawl space and closed in the cold weather to help keep the house floors warm. Historically there has been a problem getting homeowners to understand the importance of opening the vents in the summer. There has also been a tendency to disconnect exhaust fans which are noisy and viewed as energy wasters. Furthermore, in a house with only a 15 amp electric service, an exhaust fan must compete for space in the electrical panel with all other electrical appliances.
3. Insulate to Eliminate Cold Spots - Condensation occurs when humid air passes over a sufficiently cold surface. The serious condensation problems that were found where beams or joists penetrated outside foundation walls have been largely eliminated in new construction by insulating the outside of the foundation. This has had the effect of raising the temperature of the ends of the beams or joists by reducing heat loss from them. Warmer surfaces mean less condensation.

4.4 Floor Systems

For this discussion, floor systems will be defined as the: finish floor surface, floor decking, floor joists or trusses and the floor insulation and air/vapour barrier (if installed).

4.4.1 Characteristics of Good Design

1. Warmth - Floors should be warm, especially in those houses with young children or older occupants. Cold floors are not only uncomfortable but are more prone to condensation damage. Problems are most common in houses without heated crawl spaces in which the floor insulation is the only thermal barrier.
2. Durability - Floor coverings in northern housing are subjected to very heavy traffic and must be tough and durable. Ideally they should be stain resistant, easily cleanable and resilient to moisture.
3. Maintenance - Standard 1' x 1' (0.30 x 0.30 m) floor tiles have been extensively used in the past because they are easy to install and to replace if a tile is damaged or worn. Sheet flooring is more difficult to maintain because repairs are a more specialized skill.
4. Rigidity - Excessive floor flexibility will result if the joist or truss span exceeds prescribed limits. Under most conditions, this limits the maximum span for floor joists to 20' (6.10 m) or less depending on joist size and spacing. Floor trusses allow virtually any distance to be spanned but with an attendant increase in truss depth and cost.

4.4.2 Existing Conditions

Standard 1' x 1' (0.30 x 0.30 m) tiles are the most common finish floor material although sheet flooring and carpets are becoming more common. Typical sub-floors are 5/8" (16 mm) spruce sheeting with a 5/16" (8 mm) fir underlay or 5/8" (16 mm) tongue and groove select fir plywood. Sub-flooring may or may not include an underlay. Wood joists are usually made from 2 x 8 or 2 x 10 material; wood trusses are fairly rare. Steel beams have been used in a few applications to eliminate the need for a centre beam.

Floor surfaces are often in poor condition, generally as the result of heavy wear. Tiles are occasionally worn down to the sub-floor in heavy use areas such as entrance ways or burnt down to the sub-floor under the wood stove.

Insulated floor systems typically use R 28 (RSI 4.93) glass fibre batts with chicken wire support. Occasionally a sheet material, such as plywood, is used under the floor joists to offer protection against animal damage. The polyethylene crawl space ground sheet is often missing or badly damaged.

In general, floor system problems are regarded by the Design Team as a medium priority item.

4.4.3 Problems

1. Cold Floors - Houses with open crawl spaces or with insulated crawl spaces whose vents are (incorrectly) left open during the winter months will have cold or cool floors. However, this may not always be considered a major problem by the inhabitants since footwear is generally worn indoors.
2. Damaged Floor Tiles - Lifted or cracked floor tiles are common. Lifting is caused by moisture penetration through seams between tiles and is most common near doors. Once the tile has lifted and is not replaced, the sub floor is left vulnerable to moisture damage. Cracking is caused by a combination of extreme cold and heavy usage.
3. Differential Movement of Central Beam - In those communities with unstable soil conditions, houses with central floor beams are vulnerable to differential movement problems if the floor beam is not adjusted to compensate for soil movement. This movement can cause the center of the house to rise or fall relative to the outside walls with potentially disastarous consequences for the house structure.

4. **Floor Flexibility** - The sizing and spacing of floor joists or trusses is determined by their ability to minimize deflection and prevent a "bouncy" floor. Even though the floor may be strong enough to support the load, too "soft" a floor will feel uncomfortable to the occupants. This is particularly a problem in houses without central beams where floor spans are stretched.
5. **Damaged Insulation** - Damage to floor insulation by dogs or other animals is occasionally reported if the crawl space is open and the bottom side of the floor joist is not protected by plywood or some other material.
6. **Floor Joist Rot** - Wood rot in floor joists is occasionally reported when the crawl space is not vented and the water table is very high and/or a polyethylene ground sheet has not been installed.

4.4.4 Possible Alternatives

1. **Sheet Flooring** - Despite its disadvantages of higher cost and greater difficulty to repair, cushioned sheet flooring is very durable and more resistant to water damage than floor tiles because it has fewer seams. It is particularly well suited to entrance ways where most water will collect. Suitability of different types and brands needs to be investigated.
2. **Fire Protection** - Wood stoves should sit on a suitable fire-proof insulated surface so the finish flooring is protected against heat build-up.
3. **Foundation Design** - If a central beam is used and if differential movement occurs, then adjustment of the beam must be performed as required. The other recommendations pertaining to foundations also apply.

4.5 Exterior Walls

4.5.1 Characteristics Of Good Design

1. **High Thermal Resistance** - Walls usually constitute the largest single component of the building shell and should thus have as large a thermal resistance as economically and practically possible. If the wall has a high thermal mass it should be inside the insulation, although the benefits of high mass walls are limited in very cold climates. There may be overheating problems in smaller houses heated with wood stoves, if the wall (and the rest of the building envelope) is very heavily insulated.
2. **Low Air Leakage** - Low air leakage will produce lower heating costs, fewer cold drafts and less moisture damage to the walls. Since most air leakage occurs at the joints between the major components of the building, such as the joint between the floor and exterior wall, special care has to be taken to ensure that a continuous air/vapour barrier is installed across these areas.
3. **Weather Resistant** - The exterior surface must be resistant to wind, rain, snow and sleet as well as able to withstand a degree of impact loads from people and vehicles.
4. **Durability** - The entire wall must be durable. In particular the interior surface finish must be tough and able to take the high occupancy levels to which it will be subjected. Ideally, interior surfaces should be washable.
5. **Fire Resistant** - The wall assembly must have a fire resistance rating at least equal to that required by the National Building Code. Additional protection may also be required near wood stoves or other sources of heat.
6. **Structural Integrity** - The wall must not only be capable of carrying the load of the roof and any upper floors, but should also be capable of withstanding a degree of foundation movement.
7. **Low Maintenance** - Low maintenance is particularly important because of the difficulty and high costs associated with repair

work in the North. This requirement may preclude the use certain materials such as vinyl or aluminum siding if tradesmen familiar with these materials are not available.

4.5.2 Existing Conditions

Most older housing within the Study Communities is constructed using 2 x 4 wood frame construction with R 12 (RSI 2.11) glass fibre batt insulation and a 2 or 4 mil polyethylene vapour barrier. Interior surfaces are usually low quality pre-finished, panelboard, typically 1/4" to 1/2" (6 to 13 mm) in thickness. Drywall is used in a few communities. Exterior surfaces are commonly scored plywood panels such as Ranchwall with a thickness of 3/8" or 1/2" (10 or 13 mm). Exterior grade plywood or manufactured lap siding is occasionally found. Building paper and in some cases 7/16" (11 mm) fibreboard is used under the exterior surface. Stud spacing is the standard 16" (0.41 m) O.C. Exterior and interior trim and moldings are usually made from low quality material.

Within the last five to eight years, 2 x 6 construction has been introduced to allow R 20 (RSI 3.52) insulation to be used. Stud spacing has been left at 16" (0.41 m), largely to prevent excessive deflection of the interior surface. There has also been a greater emphasis on airtight construction. As a result, 6 mil polyethylene is now being used for the air/vapour barrier and major seams are sealed with a quality caulking (such as acoustical sealant) instead of with just staples which do not provide adequate sealing.

In most communities, this type of construction has performed reasonably well, especially when one considers the severity of the climate. Most problems have been appearance related. For example, weathering of the exterior finish is very common, giving homes an aged appearance. Interior surfaces are both cheap in cost and appearance and can withstand very little abuse.

Moisture damage to interior wall surfaces is not as common now as it was in the past. It is usually restricted to the areas directly under windows where condensation has formed and dripped onto the interior wall surface or seaped into the wall. In these latter cases, wood rot may occur.

Some damage to exterior walls may result when foundation shifting occurs. This can cause walls to shift making operation of doors and windows very difficult.

In some communities log construction is encountered, although its application is limited numbers. Log houses are constructed from either manufactured or site-cut logs. The nominal log wall thickness varies from perhaps 5" to 8" (127 to 203 mm). In some cases where sufficient quantities of long, straight timber of adequate thickness are not available, walls have been constructed using 4' to 8' (1.2 to 2.4 m) logs laid up in horizontal and vertical sections.

In general, wall-related problems are regarded as a medium priority concern.

4.5.2.1 Types of Exterior Wall Construction

To provide the reader with some additional background, the following discussion has been included on different types of exterior wall construction.

There are literally dozens of different types and combinations of wall constructions. For discussion purposes these can be grouped into the following six general classifications:

1. Conventional Stud Frame Wall

   Description - This is the standard type of exterior wall construction now used in the north and typically employs 2 x 6 studs with glass fibre batt insulation. Nominal thermal resistance of the complete wall is R 20 (RSI 3.52). Using studs wider than 6" (0.15 m) to allow extra cavity insulation is not considered practical. Low air leakage can be obtained but generally requires considerable care and attention with the air/vapour barrier since it is installed just behind the interior wall finish.

Advantages

- Well known and understood in the north
- All materials readily available
- Moderate levels of insulation and airtightness can be attained

Disadvantages

- Cannot practically attain wall insulation above R 20 (RSI 3.52)
- Electrical boxes and other penetrations through the air/vapour barrier require careful sealing

2. Single Stud Frame Wall With Strapping

Description - Horizontal 2 x 2 or 2 x 3 strapping is applied over 2 x 6 wall studs to allow extra insulation to be applied while reducing much of the thermal bridging that would occur if, for example, 2 x 8 construction were used. If interior strapping is used and the air/vapour barrier is placed between the studs and straps, better airtightness can be obtained since the polyethylene is not directly behind the interior surface finish. Routing electrical and plumbing lines in the strapped cavity is very easy and does not require penetration of the air/vapour barrier. Strapping can also be applied to the exterior of the wall. This does not permit a sandwiched air/vapour barrier. If vertical board siding is used however, additional horizontal nailing battens are not required. The nominal thermal resistance of strapped 2 x 6 walls is typically R 27 to R 30 (RSI 4.76 to RSI 5.28).

Advantages

- Allows higher insulation and airtightness levels than conventional stud framing
- Relatively easy to construct
- Eliminates need for cross-bridging at partition walls (interior strapping only)

Disadvantages

- Interior strapping reduces useable space of house
- Extra material required

3. Single Stud Frame Wall With Insulated Sheathing

Description - The insulated sheathing is usually applied to the exterior and increases the nominal thermal resistance of the wall and also eliminates any thermal bridging through the studs and floor headers. Several different products can be used including:

- expanded polystyrene (e.g. white beadboard)
- extruded polystyrene (e.g. blue "Dow SM")
- rigid fiberglass (e.g. "Glasclad")
- polyurethane/polyiscocyanurate (e.g. "Thermax")

Most sheathings also provide a reasonably effective air barrier for the wall exterior thus reducing wind movement through the insulation. The nominal thermal resistance of a 2 x 6 wall with insulated sheating varies from R 25 to R 32 (RSI 4.40 to RSI 5.64). See Figure 4.2.

Advantages

- Thermal bridging is eliminated.
- Moderate insulation levels can be attained
- Conventional structural sheathing can be eliminated with some insulated sheathings
- Effective air barrier can be created
- Does not reduce interior house dimensions

Disadvantages

- Insulated sheathings are expensive
- Trades experience with most insulated sheathings in the north is limited
- Expanded polystyrene, polyurethane and polyisoccyanurate, are easily damaged on site
- Due to extreme light weight, careful site supervision is required to prevent winds from blowing sheathing away

- Air/vapour barrier is left unprotected behind interior surface finish
- Framing for doors and windows is complicated
- Additional supports may be required for exterior siding

4. Single Stud Wall With Strapping and Insulated Sheathing

Description - Basically a combination of wall types 2 and 3, 2 x 2 strapping is applied to the interior of a 2 x 6 stud frame and an insulated sheathing applied to the exterior. Since it is a strapped wall, a sandwiched air/vapour barrier can be constructed and air leakage is usually low. The basic advantage of the system is that it allows reasonably high insulation levels to be obtained without going to the extra complexity of a double wall. The nominal thermal resistance is typically R 32 to R 40 (RSI 5.64 to RSI 7.04).

Advantages
- Allows high insulation levels and airtightness to be attained
- Relatively easy to construct
- Eliminates need for cross-bridging at partition walls
- Eliminates thermal bridging
- Conventional structural sheathing can be eliminated with some insulated sheathings

Disadvantages
- Expensive
- Strapping reduces useable space of house
- Trades experience with most insulated sheathings in the north is limited
- Some insulated sheathings easily damaged on site
- Storage of insulated sheathing critical to prevent material losses due to wind
- Framing for doors and windows more complicated
- Additional supports may be required for exterior siding

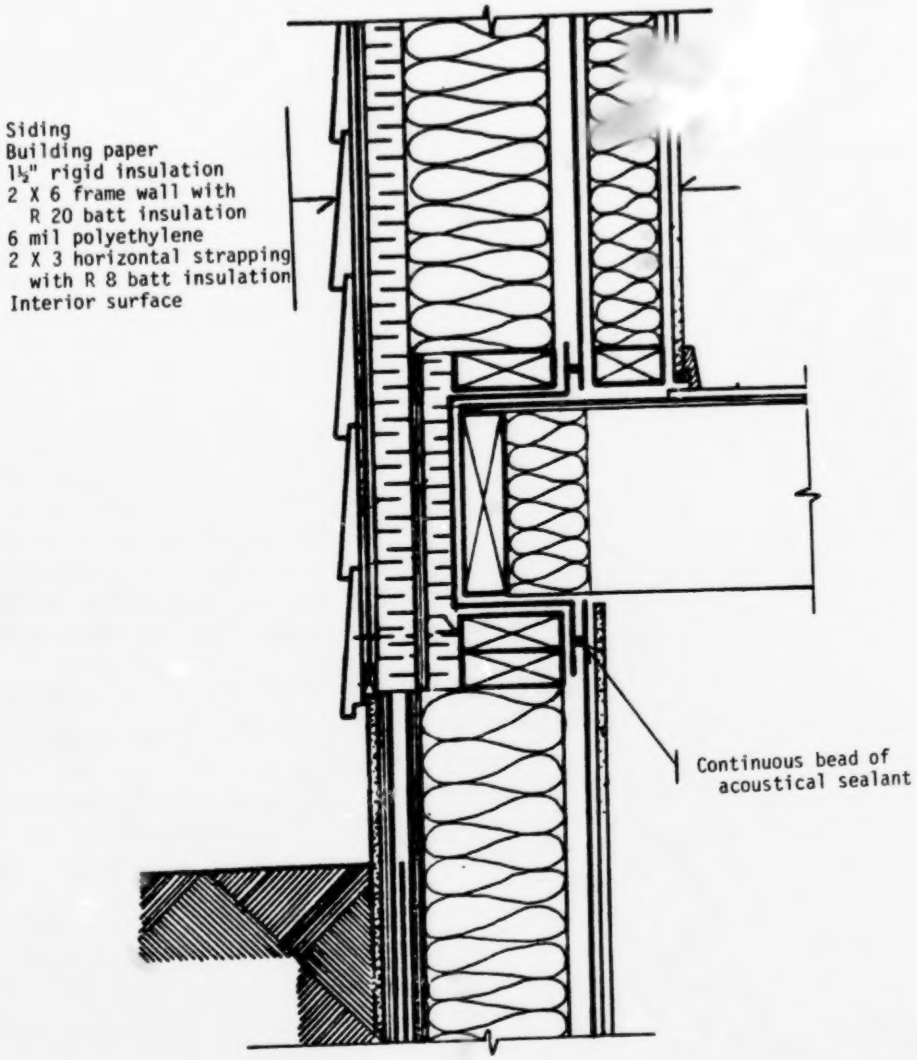

Siding
Building paper
1½" rigid insulation
2 X 6 frame wall with R 20 batt insulation
6 mil polyethylene
2 X 3 horizontal strapping with R 8 batt insulation
Interior surface
Continuous bead of acoustical sealant

FIGURE 4.2

SINGLE STUD WALL WITH STRAPPING AND INSULATED SHEATHING SHOWN ON A PRESERVED WOOD FOUNDATION

5. Double Wall Construction

Description - Double walls consist of two separate, framed walls joined together either at the top and bottom or with inter-connecting trusses. Generally double 2 x 4 or 2 x 4 and 2 x 3 construction is used. One wall is load-bearing while the second supports the interior or exterior finish. The wall thickness can be easily adjusted to attain any level of thermal resistance desired. In most applications, double walls sandwich the air/vapour barrier behind the inner wall sheathing. Extremely low air leakage rates can be achieved. The air/vapour barrier must be very carefully routed to ensure it is installed around floors, the foundation, etc. and that it does not inadvertently get installed on the cold side of the wall. Although the double wall is definitely the ultimate in energy efficiency, it is expensive and requires crews trained in the technique to build it. Nominal insulation values usually range from R 40 to R 60 (RSI 7.04 to RSI 10.57). See Figure 4.3.

Advantages

- Very high insulation and airtightness levels can be attained
- Thermal bridging is eliminated
- Plumbing and electrical lines can be routed through the interior wall
- Tends to produce a very quiet interior

Disadvantages

- Expensive
- Experienced framing crews must be used
- Door, window and corner details are very complex
- Installation of insulation is weather dependent
- May, with some designs, considerably reduce the useable space of house
- Raising walls is difficult due to their weight
- Construction sequencing critical
- Structural support for exterior wall must be considered

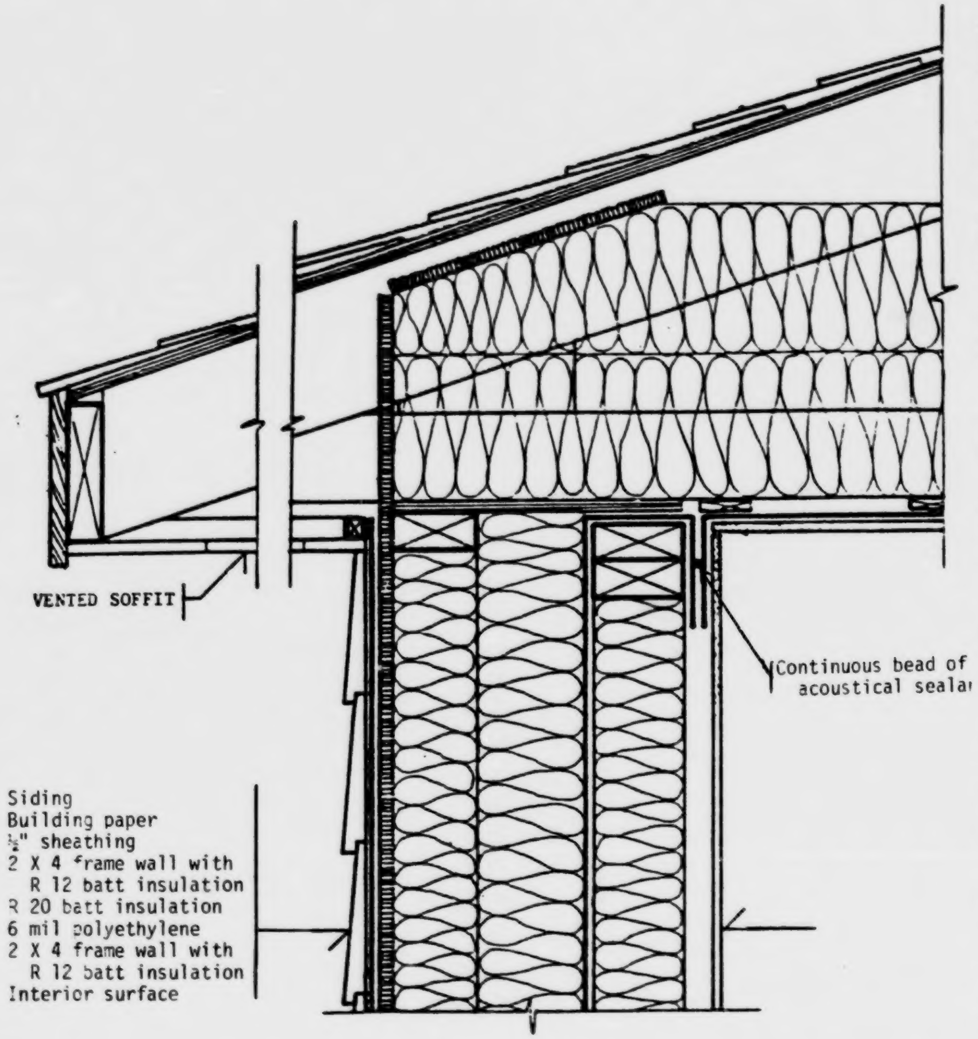

VENTED SOFFIT
Continuous bead of
acoustical seala
Siding
Building paper
½" sheathing
2 X 4 frame wall with
R 12 batt insulation
R 20 batt insulation
6 mil polyethylene
2 X 4 frame wall with
R 12 batt insulation
Interior surface

Figure 4.3

Double Wall

6. **Log Construction**

Description - Conventional horizontal log construction is often suggested as a possible wall construction technique for the North. It is popular among some northern residents and it does offer a very durable building if properly constructed. Its disadvantages include a low thermal resistance (approximately R 1 for each inch of nominal log diameter, i.e. a wall built with eight inch diameter logs will be approximately R 8). Air leakage between the logs and at corners is often very high. Because it is a labour intensive technique, construction costs are high. Furthermore as one goes north and the climate becomes colder, the average diameter and length of available timber decreases. In an attempt to increase the thermal resistance, various manufactured logs are available which incorporate insulation - such as polystyrene into their design. While this does improve the performance of the wall, it also adds to the total cost.

Another attempt to utilize log construction is the "Stackwall" system in which logs of any diameter are stacked like cord wood in a mortar framework so that the log ends are exposed. Insulation, usually treated sawdust, is placed in a cavity between the interior and exterior mortar courses. Wall thickness is typically 24" to 36" (0.6 m to 0.9 m). As with conventional log construction however, the net R-value is comparatively low and air leakage very high, unless a surface covering or insulated membrane is added. The Stackwall system is most suitable for owner/builders who are willing and capable of contributing significant amounts of sweat equity.

Advantages

- Very tough and durable interior and exterior surfaces
- High consumer appeal for some northern inhabitants (conventional log construction)
- High fire resistance
- Enhanced capacity to absorb excess indoor moisture

Disadvantages

- Low thermal resistance and high air leakage
- Somewhat fragile structurally (Stackwall)
- Requires skilled craftsmen
- Proper sized logs may be difficult to obtain in sufficient quantity (conventional log construction)
- Proper foundation design is critical. Structural weight and wall thickness complicates foundation design
- Routing of electrical and plumbing lines more difficult than frame construction
- Can be more expensive than conventional framing
- Warpage and twisting can be a problem
- Log shrinkage in the Stackwall system significantly increases overall air leakage

4.5.3 Problems

1. **Low Thermal Resistance** - The heat loss from a conventional 2 x 4 wall with R 12 (RSI 2.11) insulation is excessive for northern applications. Increasing the wall insulation to R 20 (RSI 3.52) with 2 x 6 construction reduces the conduction heat loss by approximately 40%. Although the optimum wall insulation level for northern applications is difficult to determine, R 20 is below the optimum. Heat loss is also a major problem with log construction since the thermal resistance of most log walls is less than even that of a 2 x 4 frame wall.
2. **Excessive Air Leakage** - Considering the construction styles and the number of occupant complaints which have been received, it appears that air leakage through wall assemblies is often excessive. Some of the sources of leakage include electrical outlets, door and window trim and the joints between exterior walls and the floor. It can also lead to moisture intrusion into walls which can potentially lead to wood rot and/or ice bulging of the wall.
3. **Wall Shifting** - Wall shifting caused by foundation movement is a problem in certain areas, particularly those communities on the

eastern side of Lake Winnipeg. Shifting usually results in problems with door and window operation as the frames move out of square.

4. Surface Weathering - An all too common sight in the Study Communities is the very weathered appearance of exterior walls. Caused by sun fading and general environmental erosion, the weathered surfaces not only look unattractive but are more vulnerable to moisture damage.
5. Moisture Damage - Moisture damage is a problem in some houses, although it is not as significant as often reported. It is most common in houses with high occupant loads. Most damage occurs under windows where condensation has dripped down or into the wall. Frost is occasionally found on baseboards especially in the corners of the house. When it melts, water damage may result.
6. Lack of Interior Wall Finish Strength - Since very thin panelling is generally used as the interior surface finish, it is not surprising that problems are often encountered with excessive deflection.
7. Trim and Flashing - Most interior and exterior trim is low grade, thin material which often has a short service life. Exterior corner trim, for example, is easily damaged or removed by children. Flashing around windows is sometimes installed incorrectly or not at all.
8. Construction Damage - Like all construction sites, a partially-completed house will attract children and the curious. This sometimes results in damage to the building which can be very expensive or difficult to repair. In particular, soft or fragile materials such as fibreboard sheathing, windows or exposed polyethylene have to be protected.
9. Re-location of Partition Walls - Occasionally there is a desire on the part of the occupants to re-locate interior partition walls to better meet their needs as the family grows or changes. Since the partition walls were not designed to be moved, doing so may result in considerable damage to the exterior walls, floor and the ceiling.

4.5.4 Possible Alternatives

1. Increased Thermal Resistance and Reduced Air Leakage - As previously described, there are a number of possible types of wall systems that can be constructed to increase the overall thermal resistance and decrease the air leakage. To determine which is most appropriate for a given community requires careful consideration of several factors. This will not necessarily produce the same "answer" for all applications since the conditions vary so much between communities.

The factors in favour of highly insulated, airtight wall construction are the high cost of energy and the very cold climate. On the other hand, several factors argue against major improvements beyond the (now) standard R 20 (RSI 3.52) 2 x 6 wall. The most significant of these is the relative low to medium priority of wall-related heat loss problems. In light of the more pressing problems of foundations, heating systems, doors and windows, and the limited funds available to increase the energy efficiency of new housing, it is doubtful that major improvements in the thermal performance of wall assemblies can be justified at this time. Further, many of the more heavily insulated, thicker wall sections intrude on the interior dimensions of the house reducing the useable floor space of houses in which floor space is at a premium. Consideration also has to be given to the availablity of trades skills. Many of the more energy efficient wall sections require specially trained framing crews to construct them. Double walls, for example, have on occasion, produced poor results when the crews constructing them were not properly trained. Wall systems which use exterior insulated sheathings require expensive materials with which most northern construction crews have limited experience.

Finally, there is the question of log construction. There is no doubt that it is seen as the preferred building technique by many people in the north. If properly constructed, log walls are very durable, fire resistant and have a natural charm that blends beautifully with the north. However, there is also no question that their excessive heat loss and air leakage are incompatible with energy efficient design. Furthermore, they can be expensive to build properly and generally require construction skills which are in limited supply in most communities. For these reasons, log construction cannot be recommended as an alternative for energy- efficient house construction.

It is our opinion at this time that the most reasonable, practical and appropriate types of exterior wall constructions to consider are:

A) Standard 2 x 6 frame wall with R 20 (RSI 3.52) insulation

B) Standard 2 x 6 frame wall with interior strapping for larger houses in which the reduced dimensions can be tolerated

C) Standard 2 x 6 frame wall with exterior strapping for smaller houses in which the loss of floor space cannot be accepted

D) Standard 2 x 6 frame wall with exterior insulated sheathing (either Dow "SM" or Glasclad^R).

All of these wall sections would use the standard techniques for airtight house construction including 6 mil polyethylene sealed with acoustical sealant as the air/vapour barrier.

2. More Durable Exterior Surface Materials - Many of the existing types of materials used for the exterior surface could be improved upon by using more durable and weather-resistant materials. This would improve the performance and appearance of the wall and add extra protection against exterior moisture damage.

3. Thicker Interior Surface Materials - The common ¼" (6 mm) panelboard now in widespread use as an interior finish is too thin and weak for the intended application. Thicker material or even two layers (such as locally produced boards covered with panelboard) could be used to improve the durability of the wall and protect it from damage. If drywall is used, it should be installed with screws to prevent nail-popping.

4. Stronger Sheathing - Currently 7/16" (11 mm) fibreboard is used as sheathing in some communities. This could be replaced with 3/8" (10 mm) waferboard (such as "Aspenite") which is stronger, less flexible and is more resistant to site damage.

5. Improved Air Barrier - Building paper is currently used in most communities as an exterior air barrier and to protect against moisture penetration. A more suitable product to consider is "Tyvek", a spun-bonded polyolefin which is available in 10 ft (3.0 m) widths. It is more durable and better capable of resisting air movement in the insulation caused by wind.

6. Improved Trim - Corner, door and window trim should be a higher quality material to have a longer service life.

4.6 Windows

4.6.1 Characteristics of Good Design

Windows used in northern houses are subjected to harsh conditions which often reduce their service life to a fraction of those in the south. The characteristics of windows designed and manufactured for the North should include:

1. High thermal resistance - Typical R-values for windows span a broad range:

single glazing	R 1.0 (RSI 0.17)
double glazing with ¼" (6 mm) airspace	R 1.8 (RSI 0.31)
double glazing with ½" (13 mm) airspace	R 2.1 (RSI 0.37)
triple glazing with ¼" (6 mm) airspace	R 2.7 (RSI 0.47)
triple glazing with ½" (13 mm) airspace	R 3.3 (RSI 0.58)
quadruple glazing	R 4.0 (RSI 0.70)

   Slight variations will occur depending on the area of sash relative to the total glass area, the type of sash, the type of frame and the glazing material.

2. Low air leakage rates - The National Building Code sets maximum acceptable air leakage rates for windows. For northern applications, this amount of leakage is too high. A more appropriate value would be 20% to 40% of these figures.

   Generally speaking, the tightest windows are non-operating units, followed by casements, awnings, sash sliders, and finally sashless sliders. However if the installation or weatherstripping is poor, leakage rates can increase dramatically. Windows should have the inner pane of glass tightly sealed and the air spaces between panes of glass vented to the exterior to prevent interstitial condensation (i.e. condensation between the window panes).

3. Durability - Frames should be ruggedly built to reduce breakage during transport and in use. Mechanical operating mechanisms should be much stronger than those currently in use and should be easy to replace or repair. Plastic components should be capable of withstanding very cold temperatures. All components should be resistant to condensation and ice damage. Furthermore, the windows should be very resistant to air leakage. Finally, any weatherstripping should remain flexible and functional at extremely cold temperatures.

4. Functional as a fire exit - This will require the entire window unit or at least the glazed partitions to be easily opened with a clean exit (i.e. no protruding glass), resistant to ice jamming and installed at accessable heights.

4.6.2 Existing Conditions

By far the most common type of windows in the Study Communities are double-glazed, vinyl sash horizontal sliders. Other types of horizontal sliders, such as wood, aluminum and sashless units are also encountered occasionally. Casement, awning and non-operating windows are also found in a few cases. Operating units often meet with limited success due to hardware damage. Triple glazing is found in some recent construction. Manitoba Housing has used triple glazing with success in its public housing programs although air leakage around the frame was noted as a major problem. Historically however, low cost double glazed windows have been used simply because of budget restrictions. Polyethylene is often placed over the outside of windows to provide extra thermal resistance and reduce air leakage in the winter.

The standard vinyl sash, double glazed horizontal slider can be regarded only as a fair window for the north. The units are generally manufactured to loose tolerances reflecting their low manufacturing cost. The design itself is neither energy-efficient nor appropriate for the north. As well they are frequently damaged during transportation and handling.

One advantage of slider windows is that broken or cracked panes can be replaced with relative ease. Unfortunately, with the limited maintanence funds available, this is often not done. Frequently, the entire window unit is replaced, frame and all, with the new unit "obtained" from the next year's housing program supplies.

Wood sliders, although subject to water staining, appear to work well.

It has also been suggested that they are somewhat less susceptible to breakage, although the reasons for this are not clear. Aluminum and sashless sliders typically function poorly due to excessive air leakage, condensation, ice formation and debris collection on the slider surfaces.

In some communities, sealed double glazed units have been used although frosting along the bottom has been reported as common. This may be due to the use of ¼" (6 mm) air spaces between glazings instead of ½" (13 mm) which significantly decreases heat loss.

One problem with windows in northern applications is that they are often used for cooling in the winter months when the wood stove is providing excessive heat. As a result condensation freezes on the slider surfaces. Damage to vinyl sashes and tracks is common when the homeowner applies excessive force to free a frozen pane.

Windows are regarded as a high priority item within the Study Communities.

4.6.3 Problems

1. The Fire Exit Problem - In most of the 12 Study Communities, the frequency of house fires is high. The second door in most houses is boarded over in the winter to save heat or simply because it is not functional. Thus the importance of windows as emergency fire exits is increased. Egress is accomplished by throwing a chair or other piece of furniture through the glass and escaping. The problems with an approach system are obvious. Broken glass may form a hazardous obstacle in the escape route. Excessive ice build-up on the glass and frame and the use of plastic or polyethylene "storm" windows can hinder escape efforts. In some cases bedroom windows are too high off the floor to be easily used by young children or the aged.
2. Glass Breakage - Glass breakage or cracking caused by structural shifting or foreign object damage is very common. In some communities, 50% of the house windows are broken. In most communities, the figure is significantly less. Maintenance programs are often over-extended, so repairs are difficult, expensive and take time to deliver. Materials for glass repairs are not commonly available in the community and replacing sealed units is particularly difficult. As previously noted, repairing broken glazing may involve replacing the entire window unit.
3. Icing - Frost build-up caused by window condensation is another common problem. Often operating-type windows are frozen so they can not be opened in an emergency. In some instances, condensation will drip down a window and leak into the wall cavity where it freezes, damaging surface finishes and potentially causing wood rot in structural members.
4. Air Leakage and Heat Loss - Although there is no available field data on the in situ air leakage characteristics of northern windows, a cursory examination suggests that it is typically quite high and may after a short period of service exceed the maximum allowable limit for new windows. This conclusion is supported by frequent occupant complaints about excessive drafts. Air leakage between the rough opening and the window frame is also common. With double glazed windows, high rates of heat loss result in cold glass surfaces which accelerate condensation problems. Slider units which use grooves instead of rails for the sash to slide on are more difficult to open and close properly because the grooves become filled with debris, insects and moisture.
5. Durability of Window Hardware - Most hardware, especially on casement and awning units are not durable enough for northern applications. Broken handles or mechanisms, frozen locks and inoperative lever arms are not uncommon. Replacement parts are extremely difficult to obtain. This is aggravated by the confusing array of hardware styles, sizes and makes available on the various brands of windows supplied to the communities by different suppliers. There are also reports of sashes being ripped from their frames when the windows were open during high winds.
6. Installation Problems - Proper installation techniques are as important as selecting the correct unit. Of particular importance is ensuring that the unit is tightly sealed into the rough opening. This is done using insulation or (preferably) foam backer rod. The wall

air/vapour barrier should then be sealed to the window frame using the techniques now employed regularly on low energy housing. It should be noted that most of the air leakage attributable to windows occurs between the window frame and the rough opening. Another problem is that window units are sometimes not installed square and when closed, the glazing does not meet the vertical portions of the sash squarely. This problem can also be caused by foundation movement.

7. Vinyl Breakage - Vinyl sash and tracks are susceptible to breakage during cold weather especially when heavy force is used to free a frozen window. If the vinyl frame cover cracks condensation may leak into the wall cavity.
8. Screen Damage - Screens are particularly vulnerable to damage from wind action, frost or children. As a result, missing or damaged window and door screens are common.

4.6.4 Possible Alternatives

1. Triple Glazing - Considering the severity of the climate in the Study Communities and the cost of energy, windows should at least be triple glazed with ½" (13 mm) spacing between panes. This will reduce heat loss and condensation problems. Furthermore air leakage rates are typically lower for triple glazed windows than for double glazed windows.
2. Better Weatherstripping - When operating units are used, high quality weatherstripping should be mandatory. Since several different types of weatherstripping are capable of providing acceptable seals, (spring loaded self-adjusting, bulb, "V" type, etc.) it is strongly recommended that window manufacturers be asked to provide copies of air leakage test data on the units they are offering for sale as well as weatherstripping replacement information. This could then be used to assist in selecting the best window values for a housing program.
3. Non Operating Units with Separate Vents - As previously discussed, operating windows have higher air leakage than non-operating units. They are also prone to frosting when opened in the winter which, in extreme cases, may prevent them from closing. A possible solution might be to use a non-operating unit with a separate vent panel, screened on the outside, with an insulated interior door which is opened to provide ventilation. This should be more resistant to ice build-up and potentially more durable. However, it does represent a somewhat radical departure from conventional designs and would thus have to be tested for consumer acceptance.
4. South Exposure - Although this relates more to the actual site design of the house, windows should be concentrated on the southern side of the house to maximize solar gain and to keep the windows clear of condensation.
5. Exterior Plastic Glazing - In an attempt to reduce glass breakage due to foreign object damage, the use of polycarbonate glazing (trade name "Lexan") has been suggested. The advantage of this material is that it is extremely impact resistant. Some of its disadvantages are its reduced stiffness, high cost and limited availability. However the primary concern is that it would prevent the use of windows as emergency fire exits. For this reason, may designers and housing officials have expressed private concern about its use. Many have stated that for liability reasons they would not consider plastic glazing for residential applications. Verbal reports have indicated that plastic glazing systems have been used in some northern applications, although the exact locations and success of the applications is uncertain. One possible answer to these concerns might be to use a double glazed glass unit with a plastic exterior storm window hinged at the top and secured along the sides and bottom with window screen clips. In the event of an emergency, the inner glass glazing(s) could be broken and the outer plastic glazing struck to break the restraining clips allowing the glazing to swing on the hinge. Care would have to be taken in the design to ensure that the plastic glazing was not susceptible to ice jamming in the gap between the sash and frame.
6. Heavier Hardware - All window hardware intended for northern applications, especially with operating units, should be of heavy duty construction. Cranks, handles, lever arms, latches, etc. should all

be the most durable available. In some cases, heavier frames and more temperature resistant sash designs are required. Better screen attachment details should also be included. All material should be capable of resisting moisture damage.

7. Northern Windows - From the preceding discussion it is obvious that a "Northern Window" embodying all the above design characteristics is required. It would be capable of functioning under these extreme operating conditions. Pre-testing, first in the factory and laboratory and then in accessible field locations should be performed prior to large scale use in the north.

A Note on Quadruple Glazing, Thermal Shutters, and Other Window Alternatives - The window solutions discussed above have dealt with alternatives which were judged the most practical for northern applications. A number of other concepts are available which were considered but rejected for cost, durability or practical reasons. These are briefly discussed below.

Triple glazing has been described as the most practical glazing system for the Study Communities. Quadruple glazing would further reduce heat loss, condensation problems and possible air leakage. However, considering available budgets, cost rules this out as an option at this time. Replacements and repairs would also be more difficult. Similarly, insulated thermal shutters have to be regarded in much the same light except to note that their performance and payback are not considered acceptable even in applications where durability is not a problem.

Other, more exotic products are also available including "heat mirrors", a window which uses a specially treated plastic film to reflect heat back into the house and air curtain windows which pass exhaust air between the two inner glazings of a triple paned window to reduce heat loss and condensation. However, these and other ideas, while having some merit and potential for northern applications, are currently far from ready for use in the Study Communities.

4.7 Exterior Doors

4.7.1 Characteristics of Good Design

Exterior doors which are designed and manufactured for northern applications should ideally have the following characteristics:

1. High Thermal Resistance - Although the area of exterior doors is a small percentage of the total building shell (typically 1% to 2%) the thermal resistance should be as high as possible, both to conserve energy and reduce surface condensation. A standard 1½" (38 mm) solid wood core door has a R-value of approximately 1.7 (RSI 0.30) while a polyurethane core steel door with thermal breaks has an R-value of approximately 5.3 (RSI 0.93).
2. Low Air Leakage - Exterior doors which are in reasonable conditions and have functional weatherstripping will be responsible for only a small portion of the house's total air leakage, probably 2% to 6%. However, if the door or its weatherstripping is not functioning properly, the leakage rate can rise dramatically thus wasting energy and creating cold drafts. Most types of weatherstripping do not function well in the north.
3. Durable Construction - All door components including the frame should be manufactured of heavy-weight material and fittings. The hardware and weatherstripping in particular should be designed for heavy loadings and should be functional at extreme temperatures.
4. Functional Hardware - In cold climates people wear heavy mitts making doorknobs hard to use, particularly if they are located near the door jamb. A better mechanism is a lever type operator and a handle to pull the door closed.
5. Functional As A Fire Exit - Although a seemingly obvious requirement, this point is worth noting since in many houses in the Study Communities, one of the two exterior doors is boarded over in the winter to minimize operating problems due to air leakage, ice build-up and general functionability.

4.7.2 Existing Conditions

Most houses in the Study Communities are initially equipped with two exterior doors complete with exterior storm doors. Exceptions include communities such as Tadoule Lake in which sometimes only one entrance is provided because of the small size of the houses. The most common type of doors are 1½" (38 mm) solid wood core, usually without any glazing and a wood storm door, with a slider window. Door sizes are usually the standard dimensions of 2' 6" or 2' 8" x 6' 8" (76 mm or 81 mm x 203 mm).

Locksets are typically hollow, light duty units. Three standard weight hinges are generally used for support. A variety of different types of weatherstripping have been used. In a few locations, insulated metal steel doors have been employed, usually equipped with magnetic weatherstripping.

Generally speaking, exterior doors are subjected to very heavy usage and very severe environmental conditions. Aside from the obvious problems of a hostile climate, the high occupancy of most Northern houses, means that doors are opened and closed much more frequently than is common in the south. Considering their light-weight construction it is not surprising that door problems are very common. Not only is air their leakage and conductive heat loss high, in many cases the ability of the door to function properly is threatened.

Storm doors are often broken or missing, either from heavy use or by being ripped off their hinges by the wind. Locksets are often broken or missing, often replaced with a crude handle. Hinges are often in disrepair. Weatherstripping, which is usually factory installed, will typically last one or two years. Magnetic weatherstripping, when used for exterior doors is often cracked due to the extreme cold and no longer functional. Air leakage around most doors is excessive.

Interior vestibules are only rarely encountered because the floor space they require is in such limited supply. Instead, simple doorless porches of limited size are added. These are usually built on after the house is constructed and are often constructed from material salvaged from other construction projects. They are sometimes large enough to provide a limited amount of outdoor storage space.

The average life expectancy of an exterior door is probably in the order of five to ten years. For this and the other reasons discussed, doors are considered a high priority item.

4.7.3 Problems

The major problem with exterior doors is their lack of durability. This limits their basic usefulness as doors and results in excessive heat losses. The specific types of problems which have been identified are summarized below.

1. Light weight frames - Door frames are typically manufactured from 2" (51 mm) nominal stock material. When the frame is milled to accommodate stops, hinges or other hardware, the remaining material may prove inadequate to support a door subject to heavy use. Extra material, in the form of blocking or reinforcing, or alternate designs which do not remove as much material are required.
2. Light weight hardware - Hinges and locksets are typically not suited for northern usage. Hinges do not provide adequate support and locksets are easily broken or loosened with heavy use. Locksets are usually of the round knob type and are difficult to use with heavy gloves. Restraining chains or door stops to prevent the door (or storm) from hitting the wall are usually absent.
3. Snow hinging - Snow and frost will sometimes build-up on the door jamb interfering with proper door closure. When this occurs along the hinge side of the jamb and an attempt is made to close the door it can lead to "snow hinging". This puts a considerable strain on the hinges and tends to cause the hinge screws to pull out.
4. Threshold snow build-up - A similar problem is caused when snow builds up on the threshold from repeated usage. This prevents proper closure and leads to forcing or slamming the door, ultimately resulting in damage. Wood rot of wood thresholds is also common. Unfortunately the use of metal thresholds appears to accelerate ice build-up.
5. Warpage - Due to the extreme temperature and humidity differences between the inside and outside surfaces of exterior doors, warpage is common in the winter. Wood doors tend to bow outward in the middle

because of the difference between indoor and outdoor humidities. Metal doors tend to bow outward at the top and bottom due to the difference in temperatures although the bowing is usually less severe than that experienced by wood doors.

6. Inadequate weatherstripping - Most types of weatherstripping do not perform well in the north. They may become rigid, brittle and do not deform to allow the door to close easily or they may crack at extremely low temperatures. They wear quickly with heavy usage and are not resistant to snow and ice build-up. Simply put they do not have an adequate service life for northern housing, especially with the limited maintenance they receive. This problem is aggravated by the fact that the exterior door usually opens inward and so the weatherstripping is on the cold side. This decreases its flexibility and accelerates cracking. The problem is particularly bad on the hinge side where the door moves across the face of the weatherstripping, twisting it as the door opens and perhaps pinching it at the edge when the door is closed. Magnetic weatherstripping, for example, often cracks at very low temperatures. Considering the large amount of warpage which normally occurs in exterior doors, the problem becomes even more acute since the weatherstripping must have greater reach to properly mate with the door surface.
7. Glass breakage - Glass breakage, is occasionally encountered with storm doors. Breakage may result from foreign object damage or from the door being kicked or slammed by the wind.
8. Inadequate size - As noted, the standard door widths of 2' 6" or 2' 8" (76 mm or 81 mm) are not adequate in many cases. To accomodate the large and bulky items which are brought into the houses (including firewood, machinery and even snowmobiles), wider doors, say 3' 0" (914 mm) may be necessary. However, wider doors require heavier hardware to withstand the increased door weight.
9. Cold air intrusion when door is open - When the door is opened in the winter, there is a rush of cold air into the house. This is reduced to some degree by the presence of a porch or by the use of a split level entry.

Although most of these problems relate to the durability of exterior doors, their effect on energy performance is obvious. Conduction heat losses through the solid wood core are high and air leakage is excessive and usually increases with the age of the door. Perhaps the most serious consequence of inadequate doors is that they encourage the practice of boarding over one of the doors, creating a major hazard in the event of fire.

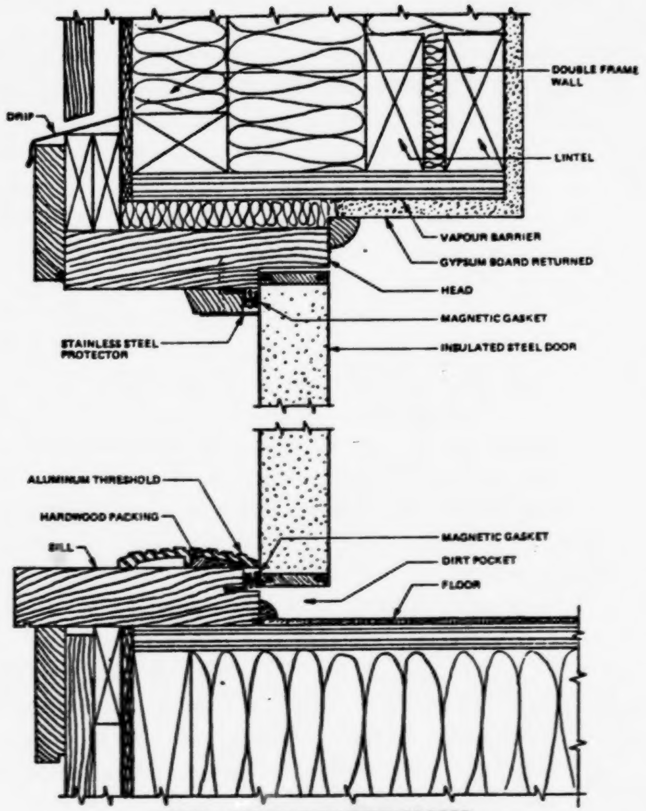
4.7.4 Possible Alternatives

1. Insulated steel doors - Since wood doors typically have a lower thermal resistance, reduced durability and greater warpage, insulated steel doors of good quality with a built-in thermal break between the inside and outside faces offer a reaidly available alternative. Discussions with Manitoba Housing indicated success with certain brands of doors in northern applications. Because of problems with cold weather cracking, magnetic weatherstripping should be avoided.
2. High quality weatherstripping - It is doubtful that any type of weatherstripping will function for extended periods of time without routine adjustment or repair. (This further makes a case for the establishment of better maintenance programs). Nonetheless, the best quality weatherstripping should be selected. Where possible, it is preferable to use double rows of weatherstripping. Any type of hair, felt, or adhesive-backed vinyl foam types should be avoided. Spring-loaded self-adjusting types which use vinyl or vinyl/metal strips in an aluminum case work moderately well but do require periodic adjustment and have a limited reach. Their best application may be when the door is installed into an unheated porch. This reduces (somewhat) the temperature and humidity differences across the door. Some types of soft bulb weatherstripping also appear to maintain flexibility at low temeperatures. Self adhesive polypropylene "V" strips can provide an excellent seal even with severe door warpage, since they have a good reach and an also be installed to mate to the door edge rather than just the face. Doors can also be closed easily with little pressure. To protect against failure of the adhesive

backing, the "V" strip back edge should be stapled to the door frame.

The bottom edge of the door on the door sweep represents a particular problem for which a perfect solution is not apparent. Since most door sweeps require a relatively clean surface to mate against, problems with snow and ice build-up can be expected. One very good solution is discussed below under "Face Mounted Threshold Seals".

3. Improved Hinge Installation Details - A very simple solution to the problem of door hinges being pulled off the door jamb is to use longer screws (3") for the hinge. The door should be positioned so that the screws pass through the finished door frame and into the 2 x 6 framing in the rough opening. Using four heavy 4-screw hinges with long screws should significantly increase the life expectancy of doors and hinges.
4. Improved Porch Design - Part of the problem of threshold snow build-up would be solved by larger porches, preferably with a door and insulated walls. This would reduce the amount of snow reaching the house door and the insulated porch would raise (slightly) the temperature of the weatherstripping and reduce the rush of cold air into the house when the doors are used.
5. Restraining Hardware - Proper design dictates that doors should not be allowed to swing completely free. Some type of padded stops, spring-loaded chains or damper mechanisms is needed to prevent the doors from slamming open into walls.
6. Heavier Frames - Closer examination of failed doors taken from northern houses would reveal several areas where the framework could be strengthened to extend the service life. In particular, heavier hinge side frames or additional blocking behind the hinges should be provided.
7. Door Handles - Lever-type door handles should be used instead of the knob type to allow easier operation when winter mitts are worn. A "D-ring" handle should be provided to pull the door closed.
8. Face Mounted Threshold Seals - The problem of obtaining a good seal against air leakage along the bottom of the door could be solved using a system in which weatherstripping mounted into the threshold mates against the door surface and thus eliminates the door sweep. An example of this arrangement is shown in Figure 4.4. This also leaves a dirt pocket underneath the door to collect shoe-borne grit and snow. The weatherstripping is protected against damage and will seat more evenly against the face of the door. Note however, that (especially with a metal door) the weatherstripping should have considerable reach to mate against the door when bowing occurs.
9. Kick Plates on Wood Doors - If wood doors are used, kickplates on the interior and exterior surface should be provided to minimize damage to the door surface.
10. Safety Glass - Any large pieces of glass used in doors, especially storm doors, should be unbreakable. Tempered, laminated, wired glass or more preferably a polycarbonate such as "Lexan" could be used.
11. Wider Doors - To accomodate bulky loads, consideration should be given to the use of wider doors. Dimensions of 2' 10" or 3' 0" (864 mm or 914 mm) are suggested. Large doors require four hinges each using four long mounting screws to support the additional weight and forces on the hinges.
12. Freezer Type Doors - One of the basic problems with conventionally-designed doors is that they fit into the jamb with a relatively tight clearance and thus dirt, snow and ice damage can interfere with closure. This is mainly a problem on the hinge side of the door where face-mounted weatherstripping is twisted as the door opens and may be pinched when the door closes. By using an oversize door which closes over the opening this problem is eliminated since the door would not move across the weatherstripping. The problem with snow hinging can also be eliminated since the hinge side edge of the door no longer has to mate against the jamb and wide clearance, gate type hinges can be used. An example of this type of design is shown in Figure 4.5.

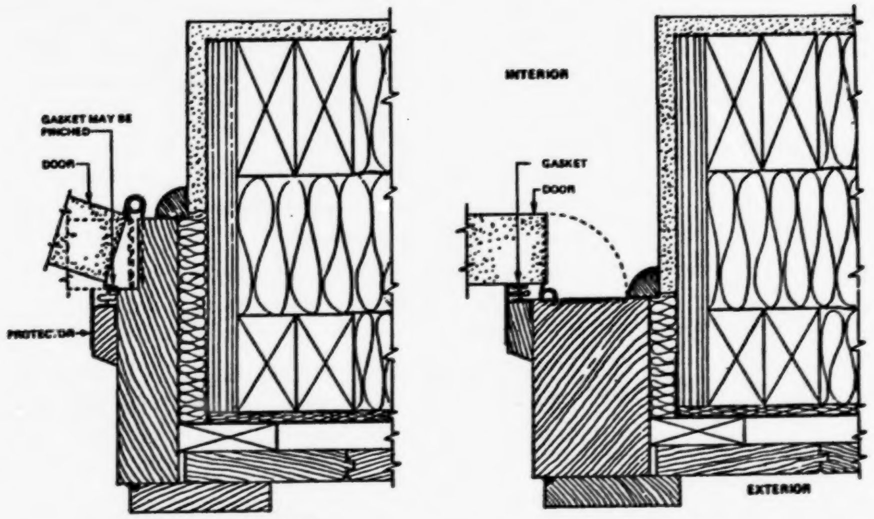

DOUBLE FRAME WALL
DRIP
LINTEL
VAPOUR BARRIER
GYPSUM BOARD RETURNED
HEAD
MAGNETIC GASKET
STAINLESS STEEL PROTECTOR
INSULATED STEEL DOOR
ALUMINUM THRESHOLD
HARDWOOD PACKING
SILL
MAGNETIC GASKET
DIRT POCKET
FLOOR

VERTICAL SECTION THRU EXTERIOR DOOR

FIGURE 4.4

DETAIL OF FACE-MOUNTED WEATHERSTRIPPING AND DIRT POCKET

(FROM "DRM 10-7 DESIGN GUIDELINES AND TECHNOLOGY FOR NORTHERN HOUSING CONSTRUCTION", APRIL 1983, DIAND)


GASKET MAY BE PINCHED
DOOR
PROTECTOR
INTERIOR
GASKET
DOOR
EXTERIOR

HORIZONTAL SECTION OF JAMB – NORMALLY HINGED DOOR (NOT RECOMMENDED FOR MAGNETIC GASKET)

HORIZONTAL SECTION MODIFIED JAMB & HINGING (FOR STEEL DOORS WITH MAGNETIC GASKET)

FIGURE 4.5

DETAIL OF "FREEZER-TYPE DOOR"

(FROM NORTHERN HOUSING CONSTRUCTION", APRIL 1983, DIAND)

4.8 Ceilings and Roofs

4.8.1 Characteristics of Good Design

1. High Thermal Resistance - Since most house designs in the Study Communities are bungalows, there is little physical impediment to increasing ceiling insulation levels to the economically-justifiable optimum. The only problem area is at the truss ends. High-heel trusses may be required.
2. Low Air Leakage - Aside from saving energy, reducing air leakage into the attic will also reduce condensation and the resulting ceiling staining and failure problems.
3. Ceiling Durability - Although reduced air leakage will minimize ceiling failure problems, the ceiling should still be durable and moisture resistant.
4. Protection Against Snow Infiltration - Wind-borne snow should be restricted as much as possible from entering the attic through the vents.

4.8.2 Existing Conditions

Two basic types of ceiling materials are used in the Study Communities, 1' x 1' (0.30 x 0.30 m) fibreboard ceiling tiles (on strapping or thin sheeting) in most older houses and plywood or sheet panels in the newer construction. Generally, the ceiling tiles perform poorly because they are very susceptible to moisture damage from attic condensation. Sheet panel ceilings perform much better because there are fewer seams to allow leakage and the material itself is much more resistant to moisture damage. Air/vapour barriers above the ceiling are now virtually all 6 mil polyethylene although older houses used thinner material which is often poorly sealed. In some communities, the construction sequence has been altered to allow the partition walls to be installed after the ceiling is in place thus allowing a continuous air/vapour barrier over the partitions. In many of the older homes, the ceiling air/vapour barrier has been extensively damaged allowing high rates of exfiltration into the attic. In the winter moisture from this air condenses and freezes on the roof sheathing and trusses and then melts in the spring. Exfiltration through partition walls into the attic contributes to this problem.

Insulation levels vary from a low of perhaps R 20 (RSI 3.52) in older houses to R 60 (RSI 10.57) in some newer construction. Coverage is occasionally poor. Glass fibre batts are the most common material although some loose fill material has been used. Occasionally the attic will be "short-changed" because some of the insulation originally allocated to it was used for other purposes. Where there is significant leakage into the attic from the living space, attic condensation problems are common. Attic spaces are also sometimes used as storage areas which may result in insulation damage or extra attic condensation problems.

Since virtually all houses are bungalows, roof trusses are extensively used. In some communities they are manufactured on site while in others pre-fab trusses are brought in from the south. Quality control problems are occasionally encountered with site-built trusses. Attic access has, in the past, been via an indoor hatch although newer construction uses gable hatches.

Roof venting is usually provided by gable vents and occasionally soffit vents. Blockage from insulation, snow or hoar frost is common.

Roof decking is fairly conventional, typically plywood or chipboard sheathing, 210 lb shingles with a polyethylene starter strip. Missing shingles are common although roof leakage does not appear to be a major problem. Eavetroughing is usually installed but is often in poor repair. Overhangs range from 1' to 2' (0.30 to 0.60 m).

Ceiling and roof problems are considered a medium priorty.

4.8.3 Problems

1. Moisture Damage - As described, exfiltration of warm, moisture-laden air into the attic and snow being blown in through attic vents can result in the accumulation of large quantities of ice and snow in the attic over the winter. In the spring, when this melts, serious water damage may result.
2. Ice Damming - The frequency of this problem is unknown but it has been reported on roofs with low slopes.

4.8.4 Possible Alternatives

1. Insulation Levels - Insulation levels should be R 50 to R 60 (RSI 8.81 to 10.57) and evenly distributed. Glass fibre batts are preferred because of their resistance to moisture damage and ease of application. Proper clearances should be left around the chimney to minimize the fire risk.
2. Sealed Air/Vapour Barrier - It is critical that a well sealed 6 mil polyethylene vapour barrier be properly installed. Electrical wiring should not be routed through the attic unless absolutely necessary. Attic access should be through the gable ends. A continuous ceiling should be installed before any of the partitions are built.
3. High Heel Trusses - High heel trusses allow extra insulation along the full perimeter of the roof and help to minimize ice-damming problems.
4. Better Roof Venting - Current roof venting strategies are not always successful at preventing wind-borne snow from getting into the attic. Although this is a problem in most regions of Canada, it is a greater problem in the north. Efforts should be made to identify vents better suited to the North. Attic venting should also exceed the minimum requirements of the National Building Code.
5. Wide Overhangs - Overhangs should be at least 2' (0.60 m) or more to provide weather protection to the exterior walls. However this will increase the snow loading and wind uplift on the roof.
6. Protection Against Truss Uplift - As the insulation level is raised, the possibility of truss uplift increases due to the greater temperature and moisture differentials between the top and bottom chords of the trusses. The effects of this problem can be minimized by proper detailing of the ceiling and partition wall joints.

4.9 Heating and Ventilation

Heating systems are a major source of problems and occupant complaints in the Study Communities. They are not only a prime cause of energy waste but have been responsible for a tragic number of fire deaths and injuries over the years. Ventilation systems are either crude or non-existent.

4.9.1 Characteristics of Good Design

1. Safe Operation - The primary concern with any wood-burning appliance is always safety. This should include selection of a heater which will not create an undue safety hazard, proper installation of the heater and chimney and finally correct operation, maintenance and use.
2. Efficient Operation - Although standardized test results are not available, the efficiency of the 45 gallon and oval-type stoves found in many of the communities are low. In contrast, a good airtight wood stove with internal baffles and a controlled combustion air supply can operate with efficiencies of 60% to 75%. Also important is the use of seasoned wood since this increases the combustion efficiency of the heater and reduces creosote formation in the chimney.
3. Even Heat Distribution - Uniform heat distribution is seldom a problem with a mechanical ventilation system but can be a major concern with a space heater such as a wood stove. Poor heat distribution not only causes discomfort, it wastes energy. Often the wood stove is operated too hot for extended periods of time in an attempt to heat cold areas of the house.
4. Moisture Control - In many northern houses excess moisture is a major problem. In the absence of any exhaust fans, the "ventilation system" becomes the wood heater since the draft up the chimney draws large amounts of fresh air to be drawn into the house.
5. Flat Surface for Cooking - The top of the heater is often used as a cooking surface. A flat surface should be provided to accomodate this.

4.9.2 Existing Conditions

With the exception of the odd oil heated house or the occasional electric baseboard heater, all space heating is supplied by wood heaters. Virtually all of these are stand alone space heaters which are not connected to any ductwork or air handling equipment. Wood is harvested locally and usually transported by ski-doo. Designated firewood storage areas, on either a communal or individual house level, are rare. Since wood left outside may be considered communal property, most people cut their firewood on an as-required basis. The result is that green wood is commonly used. In some areas fire-killed timber is available.

A number of different types of wood stoves are in use ranging from converted 45 gallon oil drums to oval tin stoves to the more efficient airtight designs such as the KOZI, Valley Comfort, Free Flow and Kingsman brands. Life expectancies of the oil drum or tin stoves is two or three years while the better airtight designs can last for several years. In some larger homes, two stoves may also be installed.

The most common type of chimney installations are Type A factory built metal chimneys. In many cases the connection of the wood stove to the chimney will use single-walled black stove pipe. Type M chimneys which are capable of surviving higher temperatures than the Type A are now being introduced in a few communities. The type M is manufactured with heavier gauge metal and uses extra insulation to reduce the temperature of the outer surface.

There is a wide variation in the quality of installations in the Study Communities. In some cases, cheap tin heaters, which get extremely hot, are installed directly on unprotected floors close to combustible surfaces such as partition walls or even stored firewood. In other cases, high quality airtight stoves are used and are properly installed with appropriate floor protection and radiation shields over any walls close to the stove or chimney.

Heat distribution within the houses is usually provided by natural convection from the wood stove. As a result, significant horizontal and vertical thermal stratification is common. End or corner rooms tend to be cool (or cold) if the doors are not left open. Floors can be quite cool if the house has an unheated crawl space. Forced air distribution systems are rare. Frost is occasionally found on baseboards indicating poor air circulation.

Ventilation systems are usually not provided and fresh air is supplied solely by natural infiltration. In a few houses, kitchen or bathroom exhaust fans have originally been installed. However their service life is generally short. Futhermore, they may be plugged by the occupants who consider them an energy waste and source of cold drafts. Central exhaust systems have been tried in a few cases with limited success.

4.9.3 Problems

1. Unsafe Wood Stove Installations - Unsafe wood stove installations are a common sight in may of the homes within the Study Communities. Although statistics were not available, a significant number of stoves are believed to be the converted 45 gallon drum or oval tin stove types, neither of which is properly designed to serve as the primary heat source in a house. Both are made of thin gauge metal which becomes extremely hot during normal operation representing both a fire threat and a hazard to occupants. These units are often installed without proper shielding for the floor and nearby walls. In contrast, airtight stoves operate with cooler exterior surfaces and give a longer burn with greater fire control and efficiency. It is worth noting that in those communities which use predominately airtight wood stoves, the number of house fires and deaths due to fire were reported to be very low.

   Chimneys are also a source of problems. In many cases, the metal chimney sections are installed upside-down so that the outer lip of each section is on the bottom thereby allowing condensed water and creosote to leak out. Chimneys are sometimes installed with long horizontal sections inside the house to recover extra heat. Unfortunately this also increases the possibility of creosote build-up and chimney fires. Another problem is that unseasoned wood is commonly burnt. Due to the lack of adequate storage space, firewood may sometimes be stored close enough to the stove to represent a fire hazard. Another problem also appears to be lack of maintenance and cleaning of the chimneys. Considering their usage and the type of wood being burnt, regular maintenance is critical. Smoke detectors which are checked and serviced on a regular basis by trained personnel should be included in every house. In summary, unsafe wood stove installations are a major hazard within the Study Communities.

2. Inefficient Operation - As previously described, non airtight wood stoves are very inefficient sources of heat. They are also very hard to control and require frequent loadings with firewood. Proper temperature control is also difficult to maintain. A problem has also been noted with occupant acceptance of airtight stoves in some areas. Apparently, because an airtight stove does not operate with as hot a surface as a tin stove, it is perceived to not be operating properly. This highlights the need for proper consumer education. Trained installation, inspection and maintenance personnel are also in very limited supply.
3. Poor Heat Distribution - A very common complaint is poor heat distribution within the house. Since heat distribution is usually dependant solely on natural convection forces, it is often difficult to move heat to the ends and corners of the structure especially if there are partition walls blocking the natural flow of air. Openings can be cut in partition walls to improve air flow but this increases the spread of smoke in the event of a fire. The heat distribution problem is further compounded because almost all houses are bungalows which are not as conducive to convective heat to flow as are multi-storey designs.
4. Exhaust Fan Noise - In the few cases where exhaust fans were installed, there were frequent complaints about fan noise. The absence of outdoor background noise in these rural settings contribute to this problem.
5. Exhaust Fan Venting Into Attic - A few cases were reported of kitchen exhaust fans venting directly into the attic space. This will lead to condensation build-up in the attic and ultimately water damage to the ceiling.
6. Indoor Air Quality - There are several major pollutants which can potentially degrade the quality of indoor air. In northern houses, the two most important are excess water vapour and the wood stove emissions. High humidity levels are common in some houses, mainly where water is continuously heated on the stove and several people live in the same house. This can lead to condensation problems on doors, windows and in corners and generally produce an uncomfortable environment. The wood stove can introduce a number of harmful pollutants into the house including carbon monoxide, nitrogen oxides, benzo(a)pyrene, smoke, etc. These result mainly from backdrafting of the stove. It should be noted that with the exception of general observations of humidity levels, no studies on other sources of information were found dealing with indoor air quality in the Study Communities.
7. Chimney Backdrafting (Potential Problem) - Chimney backdrafting occurs when there is a negative pressure differental across the building shell which prevents exhaust gases from being properly vented up the chimney. As a result, some exhaust gases and smoke are drawn into the house. The problem is most common in very airtight houses in which high capacity exhaust fans are used are separate combustion air supplies for the heating systems are not provided. This can represent a significant health hazard. To date, no reports of backdrafting have been uncovered in the Study Communities. However with the general trend toward tighter housing, chimney backdrafting is noted here as a potential problem to which homeowners must be alerted.

4.9.4 Possible Alternatives

1. Safer Wood Stove Installations - In many of the Study Communities, safer wood stove installations is the most important recommendation which can be made to improve the quality of housing. Rather than attempting to summarize the many details required for a proper installation, it is easier to reference the appropriate standards which should be followed (see below). These documents describe requirements for the wood burning appliance, their installation and qualifications for installers, chimney sweeps and inspectors.

CSA B365 Installation Code for Solid Fuel Burning Appliances and Equipment
- Describes the proper installation practices which should be followed for all types of wood heating appliances.

CSA B366 Standards for Space Heaters for Use with Solid Fuels
- Describes the requirements which should be followed for all wood space heaters (i.e. those which do not use mechanical heat distribution systems). Only wood stoves which meet this standard should be installed.

CSA B366.1 Solid Fuel-Fired Appliances for Residential Use
- Describes the requirements for wood heating systems which use central heat distribution systems. May become appropriate to some of the Study Communities if they are eventually connected to the electrical grid.

CSA B601 Qualification Code for Installers, Chimney Sweep Technicians and Inspectors of Solid Fuel Burning Appliances
- All installations, maintenance and inspections of wood heating systems should be performed by personnel who are qualified under this code.

Meeting a set of standards is obviously easier said than done. However, it is recommended that this be treated as a high priority and that all installations meet these standards.

2. 650°C Factory Built Chimneys - All chimneys should be the 650°C ("Type M") design. These contain extra insulation and use a heavier gauge stainless steel casing than the more common Type A vents. They are much better suited to northern applications and are designed to survive chimney fires. Their service life will be longer than that of the Type A vents commonly used.

3. Seasoned Firewood - The use of seasoned rather than green firewood will significantly improve the efficiency of the wood stoves and reduce creosote build-up. House designs should ideally include some form of indoor storage if a community wood cutting and storage program is not available.

4. High Efficiency Wood Stoves - As previously discussed, sheet metal, non airtight stoves operate at very low efficiencies. The newer, airtight stoves can provide heat at thermal efficiencies of 60% to 75% with better control of the firing rate, longer burn times between loadings and much safer operation. Once again it is worth noting that where airtight stoves are used, the number of deaths and injuries due to fire is drastically reduced.

5. Combustion Air Supplies - With the general trend towards tighter housing, there is the possibility that backdrafting problems could arise in some houses. Where this is a concern, combustion air ducts should be provided to supply outdoor air directly to the wood stove. The air inlet could be located in the crawl space (if unheated) or porch to protect it from snow. If a combustion air supply is provided, humidity levels in the house will increase since the stove is the major driving force for air leakage. If this occurs, special attention may be required to reduce moisture build-up.

6. Air Distribution Systems - Poor heat distribution is a major problem. Although increasing the insulation and airtightness levels of the building shell will help to provide more uniform temperatures throughout the house, it may be necessary in some cases to use a simple heat distribution system. In some applications the crawl space has been used as the return air plenum. A return air grille could be located near the wood stove and a small low power fan used to provide air movement.

4.10 Water Supply and Waste Disposal Systems

4.10.1 Characteristics of Good Design

1. Health and Safety - The most important considerations in evaluating a water supply and waste disposal system are its impact on the health and safety of the users. The water supply must be free from disease and harmful contaminants which may affect the user's health.

2. Practical - The water supply and waste disposal system in the house must acknowledge the realities of the lifestyle and the climate of the north. When a family goes out of town, say to a trap line, and the house is left for several days, the house may freeze up. The water supply and waste disposal system must not be damaged by this.

   The system design must reflect the local geology which may include permafrost, precambrian bedrock, high water tables and deep frost penetration. It must also consider the cost of providing these services.

3. Convenient and Comfortable - A good design will be convenient, easing daily chores and routines. It will also provide a level of comfort that encourages good personal hygiene practices. This means that an adequate supply of warm water and a warm and odour free toilet be provided in each residence.

4.10.2 Existing Conditions

With rare exceptions, houses in the Study Communities do not have running water. Water is obtained from standpipes or directly from lakes and rivers. Trucked water, widely used in the N.W.T., is not believed to be used within the Study Communities. In some areas, water is obtained by melting snow. Water is kept in a pail or pot in the kitchen and on the stove. The level of personal hygiene reflects the difficulty of obtaining large amounts of water, particularly in the winter.

Waste disposal is similarly primitive. Wash water often has to be thrown out the back door. Toilets are a mixture of outhouses, primarily for summer use, and bucket type toilets located in the washroom off the house. The buckets are hand carried to an outside disposal site and dumped as required. Ground conditions are often not suitable for in ground septic fields. This is because of high water tables, deep frost penetration or minimal overburden coverage.

In many houses, the washroom is centrally located. This makes sense in southern installations but not in housing with a bucket toilet. House designs with the washroom near an outside door are more suited to this reality.

Even to a greater extent than with other housing system, cost is the overriding factor which dictates the quality of sewer and water systems to northern housing. The question "What level of water and sewer service should be provided in the north?" is beyond the scope of this project. The discussion herein will be confined to self-contained systems with reasonable costs. In general, water supply and waste disposal systems are considered a high priority concern.

Water and sewer systems must provide acceptable standards of public health. In this respect they are a high priority item. Given that the people have a sanitary water supply in their community, the priority that individuals place on upgrading water and sewer systems is a matter of personal circumstance. Those with young children, the aged and those distant from a water source will feel more urgency in improving the water supply system than someone located near a water hydrant or lake. The Design Team considers improvement in water and sewer systems for Indian housing in the north to have a high priority.

4.10.3 Problems

1. Washroom Location - For user convenience, the washroom entrance should be centrally located. Where bucket toilets are used, it is desirable to have the washroom door located next to an outside door, so that the waste bucket does not need to be transported through the living areas of the house. Locating the washroom door next to the back door of the house will usually result in a colder room reducing user comfort. The washroom will be cold because its door is located next to a main entrance, it will likely have two outside (cold) walls and it will probably be some distance from the heater. Aside from user comfort,

other problems that can result in a cold washroom are condensation on cold wall surfaces and in extreme cases, water freezing. If piped plumbing is installed in the house in the future, freezing could be an extremely serious problem. On the positive side, cold washroom temperatures help reduce odours and insect problems.

2. Sanitation - With such basic water and waste systems, an extra effort is required to maintain public health standards. The transport and storage of potable water in open containers increases the possibility of contamination. Human waste in pit privies or bucket toilets in or near houses increases the potential for insect borne disease. Surface disposal of untreated human wastes can contaminate surface and groundwater, and possibly enter potable water supplies.
3. Inconvenience - The requirement to carry water in the winter from a lake or standpipe is a major inconvenience suffered by most homeowners in the Study Communities. The impact of this inconvenience is illustrated by the fact that water consumption in northern communities with individual water haulage is only about 10 litres/person per day while it is typically 225 litres/person per day in Canadian households connected to municipal water and sewer systems. Similarly, using an outdoor toilet, especially in the winter, or emptying a waste bucket is an inconvenience. The odour generated by an open toilet is also an inconvenience.
4. Physical Conditions - An obstical to adopting underground water and sewer services like those utilized in the south is the nature of the physical environment. In many places, bedrock makes trenching infeasible. In others, high water tables make septic fields and buried holding tanks impractical. In all cases frost penetration complicates winter operation and maintenance of buried services.
5. Water Supply - There is no piped water to individual houses. Water must be hand carried. This has the impact of greatly reducing the options available for domestic water and sewer systems. Sewage systems must be designed around the constraint of limited quantities of water in the house.
6. Lifestyle - The northern lifestyle often includes leaving the house unattended for extended periods while the household members travel out on the trap line, go on hunting or fishing trips or visit family in other communities. The fire in the stove goes out, and the house temperature may drop well below freezing temperatures for a period of days. This way of life is a major obstical to the practical application of indoor piped plumbing in the Study Communities.

4.10.4 Toilet Alternatives

Improvements in the type of toilets used in northern housing is considered to offer a great degree of improvement in sanitation, convenience and comfort levels. Products which can be considered currently available and applicable must have low water consumption in light of the water supply problems that the homeowners face, and low electrical energy use due to the limit of 15 amp residential electrical services. It should also be mechanically simple, reliable, not easily damaged by freezing and should not have complex maintenance requirements. Of the many alternatives reviewed, those that meet these criteria are mechanical seal toilets and composting toilets.

1. Mechanical seal toilets - Similar to those commonly used in airplanes and recreational vehicles. A pedal or handle opens a trap door in the bottom of the bowl. A small amount of water rinses the bowl and carries the waste into a holding tank below. The toilet requires only about ½ liter per flush and does not need chemicals. Bath water could be reused to flush the toilet. Sewer lines from this type of toilet must have fairly straight drop due to the small flush volumes, otherwise lines may clog. The need to drain the toilet from below places some restrictions on its application. If it is located directly above a crawl space, some form of pump-out system is necessary. If the holding tank is an integral part of the toilet, it must not be allowed to freeze if there are any liquids in the holding tank. One concept envisaged for houses with two floor levels involves locating a mechanical seal toilet on the upper level at an outside

wall. The sewer line from the toilet would pass through the outside wall to a compartment with the waste bucket or holding tank in it. This compartment would have an outside door and be fly and rodent proof. Waste disposal would be much the same as it is now with the bucket type toilet, except the waste would not have to be stored or transported through the house. The concept is illustrated in Figure 4.6. The cost of such an installation is estimated at $500 excluding a pressure flush system, which is not considered an essential component.

2. Composting Toilets - Otherwise known as muldering toilets, these have been developed and are commerically available from Scandanavian countries. These toilets consist of a large composting chamber or tank on which the toilet sits. Kitchen garbage and human waste compost or decay naturally in the tank leaving a relatively inoffensive residue which is a very good soil fertilizer. About once a year the composting chamber must be emptied. These toilets do not require sewer, water or electrical hookups and require very little maintenance.

   The composting chamber must be kept warm, above 45° F (7° C) if biological activity is to continue. Air is supplied through an intake near the bottom of the chamber and vented through a pipe which passes through the roof of the house. This air flow evaporates the liquids from the waste and promotes decay. The composting tank may be up to 4 feet deep by 7 feet long by 2 feet wide (1.2 x 2.1 x 0.6 m) for a large family. As such it must be put in place before the house is built and it would require a heated crawl space. The major disadvantages of this type of toilet are its cost (up to $5,000 installed) and the difficulty of removing the wastes from the composting chamber in the crawl space. Innovative design of a site built composting toilet could circumvent both of these problems.

3. Underground Holding Tanks - These can be used in conjunction with conventional plumbing systems. They must be insulated and heated to prevent them from freezing. The tank would have to be pumped out occasionally. The frequency of this requirement depends on tank size,

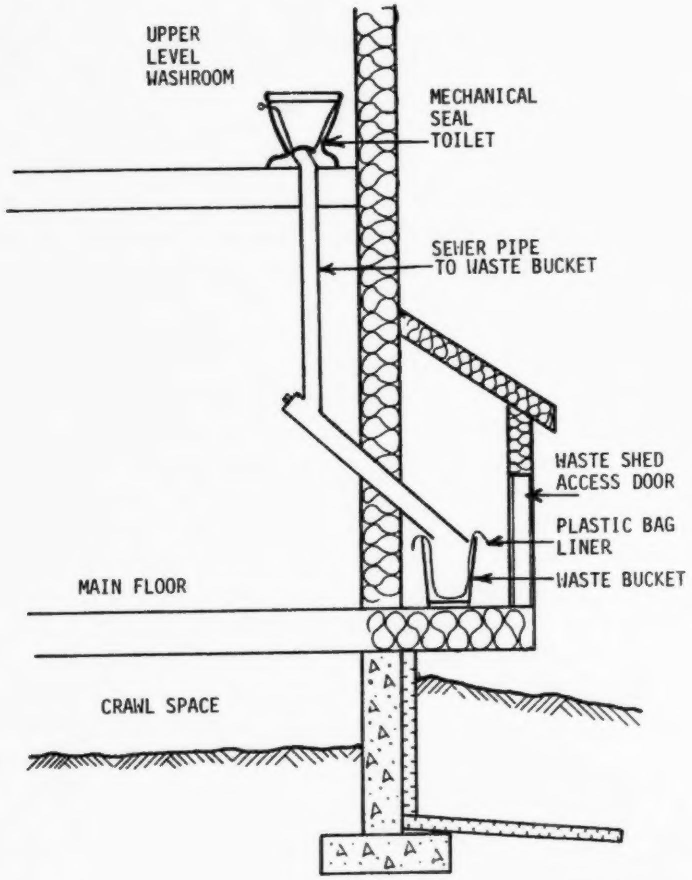


FIGURE 4.6

DESIGN CONCEPT FOR A MECHANICAL SEAL TOILET WASTE COLLECTION METHOD IN TWO STOREY NORTHERN HOUSING.

family size and on the water use of the fixtures draining to the tank. Problems with trenching, water tables and frost heaving will exclude this option from many communities.

4.10.5 Waste Disposal Alternatives

1. Greywater - The term "greywater" refers to spent wash water which does not contain human waste. Given the small quantities of greywater to be disposed of from most households, the current practice of pouring it on the ground is quite acceptable from an environmental perspective. If water is delivered to the household on a regular basis by truck or pipeline, greywater volumes are likely to increase dramatically, necessitating alternate disposal methods. Two possibilities are using holding tanks as discussed in the Toilet Alternatives section and using leaching pits. Leaching pits would only be applicable in areas with low water tables and well drained porous soils. They are not suitable in areas where potable water is sourced from wells.
2. Sewage Treatment - Community sewage treatment facilities may be needed in some communities if surface disposal of human wastes pollutes water supplies. One possible alternative to treating the sewage in a local treament plant, which would undoubtedly be extremely costly, is to haul the waste away from the community and dispose of it in a "safe" place. This may be easily done in the winter when surface transport is easy and the wastes are frozen, thus inoffensive.

4.10.6 Water Supply Alternatives

1. Trucked Water - Piped water to every house is the ultimate but an unlikely condition for northerners, in the foreseeable future. In the Northwest Territories trucked water has been accepted as the most cost effective and trouble free water supply system for remote communities. In these communities, each house is equipped with a storage tank of 200 to 500 gallons (800 to 2000 litres). The tanks, which must be located inside the heated envelope are most frequently polyethylene or reinforced fibreglass. In the winter the water may be delivered as block ice. This eliminates the need for a water tanker and all its associated problems such as freezing hoses. The house tank can be equipped with a tap at the bottom or with an electric water pump which feeds normal indoor water piping.

   Indoor water piping should be done with plastic as opposed to copper. Copper piping is more susceptible to freeze damage than plastics and harder to repair. Pipe runs should not be enclosed in walls where repairs to frozen pipes are difficult.
2. Wells - In some areas it may be possible to drive shallow sandpoint wells into the water table. If this is done inside the perimeter of the house foundation, and the house has a heated crawl space or basement, the house could have its own water supply. The sandpoint could be connected to a hand pump or to an electric well pump. The water supply must be tested regularly to ensure that it is safe for drinking and is not being polluted by the sewage disposal system. Except in extreme cases of contamination, well water would be suitable for most washing requirements (i.e. bathing, washing clothes, household cleaning).

   Wells may only work in one or two communities, and it is unlikely that they will work at all building sites in those communities.

4.11 Electric System

4.11.1 Characteristics of Good Design

1. Safety - Electricity is dangerous. A good electrical system minimizes the danger of electrical injury to the individual and of damage to property.
2. Convenience - Electricity should be available when and where required.
3. Adequate - The electrical service should have sufficient capacity to meet reasonable concurrent loads.
4. Minimal Air/Vapour Barrier Perforations - Electrical wiring is often done outside the air/vapour barrier, with perforations made as needed to bring wiring to light switches, recepticals and fixtures inside the vapour barrier. A good design will minimize the number of perforations made in the air/vapour barrier and will allow perforations to be properly sealed to prevent air leakage.

4.11.2 Existing Conditions

Remote communities in Manitoba are, by definition, those communities serviced with diesel generated electrical power. Houses in these communities are restricted to 15 amp electrical services. By southern standards, this level of service is totally inadequate. However the level of service provided to the house is beyond the scope of this study. The restriction in level of service is the major source of user inconvenience. The occupant cannot, for example, use a variety of kitchen appliances simultaneously without "popping" a breaker. Despite these problems, the electrical services are generally safe. The exceptions result when the homeowner moves interior walls with wiring in them, and the loose ends are not properly tied up or terminated.

Most of the wiring is done from the attic. The houses are wired for 100 amp service but can only use a 15 amp main breaker. In new construction, the builders apparently make a good effort at sealing around electrical boxes and conduits where they pass through the vapour barriers. Many new house designs do not have light fixtures in the ceilings, which reduces the number of vapour barrier perforations.

4.11.3 Problems

1. Moving Partition Walls - Like other homeowners, residents in the north occasionally see fit to renovate their homes. This frequently involves moving interior walls, some of which are wired. There is a problem in relocating the wiring and the switches or sockets, as the skills and materials needed to do this may not be available in the community. What is needed is a simple and safe method of unplugging and reconnecting the wires in partition walls.
2. Penetrations through the Air/Vapour Barrier - Wherever electrical wiring passes from the outside to the inside of the air/vapour barrier in the house, a hole is made in the air/vapour barrier. If the hole is not properly sealed air leakage can occur through the air/vapour barrier at this point. If the hole in the vapour barrier is for a receptical box or a light fixture the air leakage can be very substantial. The problems that can result in terms of heat loss and moisture condensation in the building envelope have been previously discussed.
3. Attic Wiring - The integrity of the air/vapour barrier in the ceiling is very important in controlling moisture problems in the attic. If the house is wired from the attic, the attic air/vapour barrier must be penetrated whenever the wiring is dropped inside the envelope. If the house is renovated and partitions are moved, the wires from the attic into the partition must be moved. During demolition and reconstruction, a lot of damage may be inflicted on the vapour barrier. Such occurrances have not been uncommon. In some severe cases, condensation has devastated ceiling finishes. The presence of water or water stains inside ceiling light fixtures is evidence that a condensation problem does exist above the light fixtures.

4.11.4 Possible Alternatives

1. Crawl Space Wiring - In houses with heated crawl spaces, it is feasible to run the wiring in the crawl space between the floor joists. The floor air/vapour barrier is generally better protected from damage than is the ceiling air-vapour barrier and in any case,

the consequence of damage to it is less severe. Access for modifications or repairs to the wiring would be easier than wiring in an attic. The wiring would be visible without moving insulation.

This approach is not suitable for houses with insulated floors because wiring would either have to be armoured or placed along the floor joists to meet code requirements. Gaining access to the wiring for modifications would necessitate removing the bottom side sheeting and insulation.

2. Double Wall Construction and Strapped Walls - Going to the inside strapping or double wall construction permits all wiring to be done inside the air/vapour barrier. This also allows increased insulation levels in the wall cavity. These wall concepts are discussed in detail in Section 4.5.
3. Wiring Chases or Troughs - All wiring could be laid in chases or troughs along the house walls. The chases would have access doors at the appropriate points. If they were located along outside walls, wiring into partitions could be relatively straightforward, as would running wires into the outside walls for recepticals or light switches.
4. Conduit Baseboards - In Europe, the concept of combining baseboard trim and electrical conduits has been developed. The baseboard trim, in effect, acts as a wiring chase. Such an approach may have some merit in northern applications.

4.12 Use of Local Materials

The use of locally-available or locally-produced building materials is an obvious opportunity to increase community employment and reduce monies spent outside the community on materials and transportation while improving the availability of supplies for repair work.

Production of framing timber from local sawmills has been tried in some communities as described in Chapter 2. The major obstacles to successful sawmill operation are: the relatively small markets which exist in most areas (although several communities could run a joint operation), the need for a kiln to properly dry the lumber and the need for trained personnel to manage and run the operation. To meet the requirements of the National Building Code, the moisture content of construction lumber must not be greater than 19% at time of installation. Lumber must also be graded and stamped by an approved inspector. Since framing lumber is the structural "heart" of a house, it must be straight and of acceptable quality.

Other than framing material, there is also considerable opportunity for the use of nominal 1" lumber for sheating, sub-floors and exterior wall finsihes. Vertical board siding, locally produced from spruce has been tried and found susceptible to warpage.

The other major local material which can be used is aggregate for cement and granular backfill. Availability varies between communities and the quality ranges from excellent to poor.

4.13 Review of Background Documents

Of all the information reviewed, three documents proved to be the most useful for the engineering component of this project. These three are:

The National Building Code of Canada, 1980 - This is the set of minimum regulations respecting the safety of buildings with reference to public health, fire and structural sufficiency.

DRM 10-7 Design Guidelines and Technology for Northern Housing Construction, April 1983 Indian and Northern Affairs Canada - This publication provides design guidelines for housing in regions of severe winter climates. Included are energy conservation measures, problems that can occur in housing in these regions and recommendations to avoid or correct these problems. This manual contains information useful to building designers, builders and maintenance personnel, and is considered invaluable to the engineering component of this study.

Northern Residential Standards for Energy Efficient Housing, June 1983 - This is a draft standard meant to replace Part 9 of the National Building Code, 1980 for northern housing. It follows the NBC, Section 9 outline, using the same topic and section number sequence, but it upgrades the NBC minimum standards to reflect the severity of Canada's northern climates and the resulting problems in housing.

Numerous other documents were reviewed, and considered to provide worthwhile background information. A listing and brief summary of these follows:

CSA B365 "Installation Code for Solid Fuel Burning Appliances and Equipment" - Describes the proper installation practices which should be followed for all types of wood heating appliances.

CSA B366 "Standards for Space Heaters for Use with Solid Fuels" - Describes the requirements which should be followed for all wood space heaters (i.e. those which do not use mechanical heat distribution systems). Only wood stoves which meet this standard should be installed.

CSA B366.1 "Solid Fuel-Fired Appliances for Residential Use" - Describes the requirements for wood heating system which are central heat distribution systems. May become appropriate to some of the Study Communities if they are connected to the electrical grid.

CSA B601 "Qualification Code for Installers, Chimney Sweep Technicians and Inspectors of Solid Fuel Burning Appliances" - All installations, maintenance and inspections of wood heating systems should be performed by personnel who are qualified under this code.

"Arctic Residential Retro-Fit, Frobisher Bay" published by NWT - CREDA - An existing house was retro-fitted by upgrading windows, insulation and reducing infiltration. As well wind/electric, thermal solar and computer monitoring systems were installed. These later three "high tech" components did not perform as expected. "The project illustrates that simple, present technology, produces a much greater return than high technology."

"Building in Northern Communities: A Report on a Conference-Workshop held in Inuvik, N.W.T., February 10-15, 1974." Organized by the Arctic Institute of North America - Due to settlement and stabilization problems, especially when using frozen fill, onsite preparation for foundations on permafrost should be started one full year in advance of construction.

"Design of Floors for Arctic Shelters" The Northern Engineer Vol. 6 No. 4 - Temperature stratification of up to 20°F was recorded in single storey houses over unheated crawlspaces in winter conditions. Insulating between the floor joists does little to improve the temperature regimes, due to air movement in unbaffled insulation. Heating the floor helps overcome the stratification.

"Water and Sanitation in the Northwest Territories" The Northern Engineer Vol. 9 No. 4 - Winter 1977 - An overview of policies and technology regarding water and sanitation systems in the N.W.T. setting.
"Piped water and sewer costs in permafrost area range between $200 and $325 per foot."
"The economic rate for water delivery and sewage pumpout in N.W.T. communities is approximately 6 to 9¢/gallon."

"Building Drawings Checklist: Electrical Drawings for Housing" by C.S. Strelka, DBR, NRC Canada Building Practice Note 41; Ottawa, February 1983.

"Building Drawings Checklist: Mechanical Drawings for Housing" by C.S. Strelka, DBR, NRC Canada Building Practice Note 40, Ottawa; December, 1982.

"A Review of the Remote Housing Program, March 1974" by Blair Bingham, Ken Cassin and John Glassco, Province of Manitoba (H.U.D. Library) - This is an internal document concerning the provincial governments housing policy.

"Northern Housing - Designs for Remote and for Self-Contained Housing Units - March 1972" by the University of Manitoba Northern Housing Committee (H.U.D. Library) - This report reviews general housing problems and recommends a number of specific research projects into these areas.

"To Build in Northern Manitoba - A report to the Government of Manitoba" Krisno Nimpuno, January 1976 - Dr. Nimpuno, a Swedish Architect with extensive experience in remote housing systems, discusses housing needs and designs based on his Swedish experience. There is a major section on developements in self-contained sewage systems.

"Canadian Foundation Engineering Manual" by the Canadian Geotechnical Society - A four part manual with suggested procedures for the design, installation and construction of foundations.

"Community Water and Sanitation Service Northwest Territories November 1981" prepared by EPEC Consulting Western Ltd., Whitehorse, Yukon - This report is on inventory of the municipal sewer and water services throughout the N.W.T.

"Water Conservation Alternatives for the North" Environment Canada Economic and Technical Review Report EPS 3-WP-80-2, Feburary 1982 - This report reviews water use characteristics, pricing policies, plumbing codes, public acceptance, water conservation experiences and methods and technologies to reduce water use and the concomitant energy requirements. Various administrative alternatives and water conservation technology for toilets, bathing, laundry, kitchen and households are analyzed with respect to appropriateness, public acceptance and cost-effectiveness.

"The Magic Box" Harrowsmith #41, February/March 1982 - Article discusses the low energy Keewatin House designed by Allen-Drerup-White and built in six N.W.T. communities.

"Arctic Architecture" pp. 18 March 1983 issue of Construction Canada - Discusses housing built from pre-fabricated freezer panels. Also discusses foundation design on permafrost.

"The Easterville Demonstration House" - Undated/unpublished article on a log house built in Easterville, Manitoba using local labour and materials.

"Natural Home Heating" April 1977, published by Manitoba Department of Renewable Resources and Transportation Services - Discusses costs and benefits of wood heating. Contains table with heating values of Canadian woods.

"Design of Roofs for Northern Residential Construction" The Northern Engineer (TNE) Vol. 5, No. 1 - Discusses design techniques to avoid common moisture and ice problems on roofs and in ceiling spaces of housing in cold climates.

"Design of Floors for Arctic Shelters" TNE Vol. 6, No. 4 - Reviews floor design methods which reduce temperature stratification in housing by providing warm floors.

"Experimental Housing Project: New Phase" TNE, issue unknown - Reviews development of polyurethane foam sandwich panel construction of housing.

"The Ideal Arctic House - II" TNE Vol. 5, No. 2 - Reviews problems faced by the arctic house designer, and the inappropriateness of southern solutions for northern problems.

"Heating the Ideal Arctic House - III" TNE Vol. 5, No. 3 - Reviews fuels, stoves and heaters, controls, ventilation and heat distribution in northern housing.

"Vapour Barriers - The Ideal Arctic House IV" TNE Vol. 5, No. 4 - Reviews moisture problems and the importance of a good air/vapour barrier in northern housing.

"Windows - The Ideal Arctic House - V" TNE Vol. 6, No. 1 - Reviews the dilema of windows from an energy conservation perspective, methods of estimating the most economical type of window (double, triple, quad), condensation problems and their solutions and recommended window construction and installation practices.

"Heat Loss and Condensation in Northern Residential Construction" Axel R. Carlson, Assoc. Prof. of Extension, Cooperative Extension Service, Univeristy of Alaska, College Alaska - This paper reviews the mechanisms which produce condensation on cold surfaces, and temperature gradients through walls.

"Design of Remote Housing in Northern Manitoba" J. Pass, Undated - Defines basic problems as inadequate health standards and excessive overcrowding. Health problems are related to poor heat distribution, condensation, ventilation, lack of living and storage space, interiors difficult to clean, cold floors, lack of crawl space, water supply and sewage disposal systems. Provides a series of design suggestions aimed at overcoming these problems.

4.14 Summary of the Engineering Design Consideration for Northern Housing

Using relevant codes, standards, studies and personal observation, the Engineering background report reviews current construction practices in the Study Communities component by component. Construction related problems are examined in detail, particularly those which affect the energy and structural performance of the house. Finally, possible solutions are identified and evaluated relative to the needs of the people and the physical environment of the communities. Considering the very real and practical problems of the north (budget constraints, climate, lifestyle, limited availability of trade skills and transportation problems) its housing problems are best addressed by applying proven design concepts, not radical departures from conventional practices.

The following is a summary of the recommendations and conclusions for the various engineering components of northern housing.

Foundations: Variations in soil conditions, house styles and materials costs in the Study Communities make it impossible to identify a single "best" foundation design for northern housing.

- Where settling or heaving are problems, eliminate the central beam by using pre-fabricated, clear span floor trusses.
- Where soil erosion is a problem, avoid building sites on hills or along drainage routes.
- Install polyethylene ground sheets under all crawl spaces.
- Except on permafrost, insulate around the perimeter of foundations to prevent the crawl spaces from freezing.
- Vent crawl spaces in the summer.

Floor Systems: This includes floor trusses or joists, decking, floor covering, in floor insulation and vapour barrier.

- Sheet flooring is recommended, especially at entrances, because of its resistance to damage from standing water.
- Wood stoves should sit on a fire proof, insulated pad.

Exterior Walls: Several wall configurations have been developed for energy efficient housing. Six of these are evaluated with respect to their ease of construction, energy efficiency and structural durability.

- The standard 2" x 6" R 20 frame wall should be used for small houses.
- Larger houses should be constructed using 2" x 6" frame walls with interior and/or exterior strapping or exterior insulated sheathing.
- Airtight house construction techniques be applied, including using 6 mil polyethylene air/vapour barrier sealed with acoustical sealant.
- Use thicker (sturdier) interior wall cladding.
- Replace fiberboard cladding with 3/8" (10 mm) waferboard (eg. "Aspenite").
- Replace standard building paper with "Tyvek".
- Use durable trim on exterior corners and around windows and doors.

Windows: Windows are psychologically important in housing in extremely cold climates. In housing with wood heat, they are also required as fire exits.

- New housing should have triple glazed windows with at least 1/2" (13 mm) air spaces between the panes.
- Operating windows should have high quality weatherstripping.
- Use non-operating windows wherever possible. Provide screened vent doors under windows where required.
- Orient houses to maximize south facing windows and minimize north facing windows.
- Specify heavy duty hardware for operating windows.
- Consider the use of "Lexan" windows.

Exterior Doors: Snow hinging and cold weather failure of weatherstripping are common problems associated with doors in northern housing.

- Use insulated steel doors for increased durability and reduced energy loss.
- Double weatherstrip doors.
- Use four heavy 4-screw hinges with 3" (76 mm) screws.
- Build porches at main entrances.
- Install restraining hardware and padded stops on outside opening doors.
- Use heavier hinge side door frames.
- Use lever type openers with D-ring handles.

- Use face mounted threshold seals.
- Use "Lexan" windows in storm doors.
- Ultimately, develop a freezer type exterior door which closes over, not into the door opening.

Ceilings and Roofs: The major problems result from water damage to the ceiling caused by air exfiltration into the attic from the living space and by wind-borne snow being blown into the attic.

- Attics should be insulated to R 50 to R 60 (RSI 8.81 to 10.57) with even coverage and adequate clearance around chimneys.
- The ceiling air/vapour barrier should be constructed from 6 mil polyethylene properly sealed at all joints with acoustic sealant. Particular attention should be paid to air leakage through partition walls and where wiring penetrates the ceiling.
- The ceiling should be completed before the interior partitions are installed.
- High heel trusses should be used to allow extra insulation at the ends of the trusses.
- Precautions should be taken to minimize truss uplift problems.

Heating and Ventilation: The greatest opportunities to improve the quality of housing in the Study Communities lie with upgrading the heating and ventilation systems. Significant improvements in safety, heating system efficiency and comfort are all prossible.

- Airtight wood stoves with internal baffles and combustion air controls should be used in place of the 45 gallon or oval-type sheet metal stoves.
- All relevant standards dealing with the acceptability of wood stoves, their installation, maintenance and inspection should be closely followed.
- Type M chimneys should be used instead of the Type A vent.
- Seasoned rather than green firewood should be used to improve the heating system efficiency and reduce the fire risk due to creosote formation in the chimney.
- The possiblity of using some simple type of air distribution system should be explored.

Water Supply and Waste Disposal Systems: Available services in most of the Study Communities are poor at best and even primitive in some cases. Aside from being uncomfortable for the people, the poor quality of water supply and waste disposal services represents a significant public health risk.

- Where an indoor bucket toilet system is used, the washroom should be located to allow easy disposal of the waste without carrying it through other areas of the house.
- Alternative toilet systems such as the mechanical seal and composting should be considered for eventual use.
- If residential water use increases in the future, more formalized water disposal systems will have to be employed.
- House designs should include provision for water storage tanks even if trucked or well water is not currently available.
- Alternative community sewage treatment systems need to be explored in greater depth.

Electrical Systems: The limitations of 15 amp service continues to pose a frustrating obstacle to the people of the Study Communities which will be eliminated only by connecting into the Provinical electrical grid. However, the existing electrical services can be designed to minimize problems with other aspects of the house design.

- In houses with insulated crawl spaces, wiring can be run in the crawl space to minimize penetrations through the ceiling.
- If strapped exterior wall systems or double wall systems are used, wiring can be routed inside the air/vapour barrier, minimizing air leakage problems caused by penetrations through the air/vapour barrier.
- For this same reason, wiring can be routed along walls, through wiring chases or in conduit baseboards.

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I. INTRODUCTION

1.1 Study Background

The problems of inadequate housing on northern Manitoba are well known to Indian People and governments alike. While much effort has been made in the past to provide Indian housing, there still remains a lot to be done to satisfy reserve housing needs. The housing on which Indian people have come to depend has suffered from a number of drawbacks, such as:

- The current housing designs do not recognize the diverse lifestyles and living requirements of Indian people,
- Houses are located on poor land with little or no modern sewer and water services,
- While northern house construction uses mostly local labour, there is almost no local materials used in building the housing.

Yet there is a chance to make some improvements in northern housing, for a number of reasons, including:

- Indian organizations are becoming stronger, and will be able to participate more in the delivery of housing,
- Housing monies have expanded beyond the $44,395 (the Manitoba maximum through DIAND's Band Housing programme),
- There have been advances in housing technology that permit the construction of more durable housing.

The Manitoba Keewatinowi Okimakanak (MKO), Inc. and the Federal Government both recognize that housing needs for reserve communities will continue to increase as reserve populations grow. Shelter is a high priority and developing better quality, energy-efficient housing is one way of helping reduce the current housing backlog that exists on reserves in northern Manitoba.

To meet this growing need to improve housing in the North for Indian People, the MKO, together with the Federal Government Departments of Energy Mines & Resources (EMR) through the Remote Community Demonstration Program (RCDP), Indian Affairs & Northern Development (DIAND) and the Canada Mortgage & Housing Corporation (CMHC), commissioned the firms of Appin Associates and UNIES Ltd. to design more appropriate energy efficient housing for Manitoba's remote communities. The project was divided into three stages, namely:

- Background Review Stage
- A Preliminary Design Stage
- A Final Design Stage

The project workflow is shown in Figure 1.1. Project community participation in the design process was seen as important. As a result, the MKO selected the four remote Indian communities of Brochet, Lac Brochet, Pukatawagan and Tadoule Lake to be involved in all three stages of the project because they felt that these communities represented a good cross section of remote northern housing conditions. The locations of all Manitoba's remote communities as defined by the Remote Community Demonstration Programme of Energy Mines & Resources Canada, are shown in Figure 1.2.

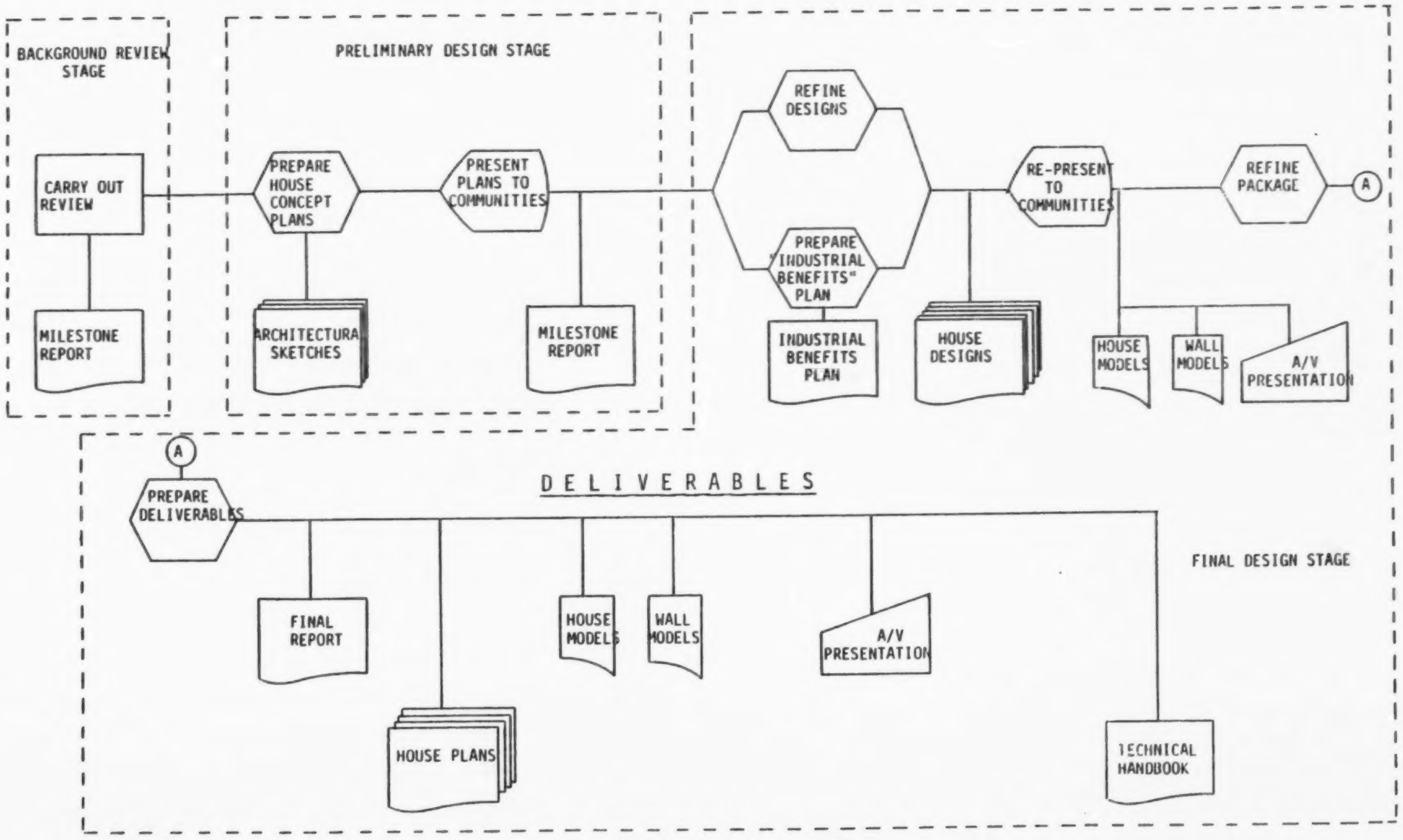

BACKGROUND REVIEW STAGE
CARRY OUT REVIEW
MILESTONE REPORT
PRELIMINARY DESIGN STAGE
PREPARE HOUSE CONCEPT PLANS
ARCHITECTURAL SKETCHES
PRESENT PLANS TO COMMUNITIES
MILESTONE REPORT
REFINE DESIGNS
PREPARE "INDUSTRIAL BENEFITS" PLAN
INDUSTRIAL BENEFITS PLAN
HOUSE DESIGNS
RE-PRESENT TO COMMUNITIES
HOUSE MODELS
WALL MODELS
A/V PRESENTATION
REFINE PACKAGE
A
A
PREPARE DELIVERABLES
DELIVERABLES
FINAL REPORT
HOUSE PLANS
HOUSE MODELS
WALL MODELS
A/V PRESENTATION
TECHNICAL HANDBOOK
FINAL DESIGN STAGE

Figure 1.1
Project Workflow

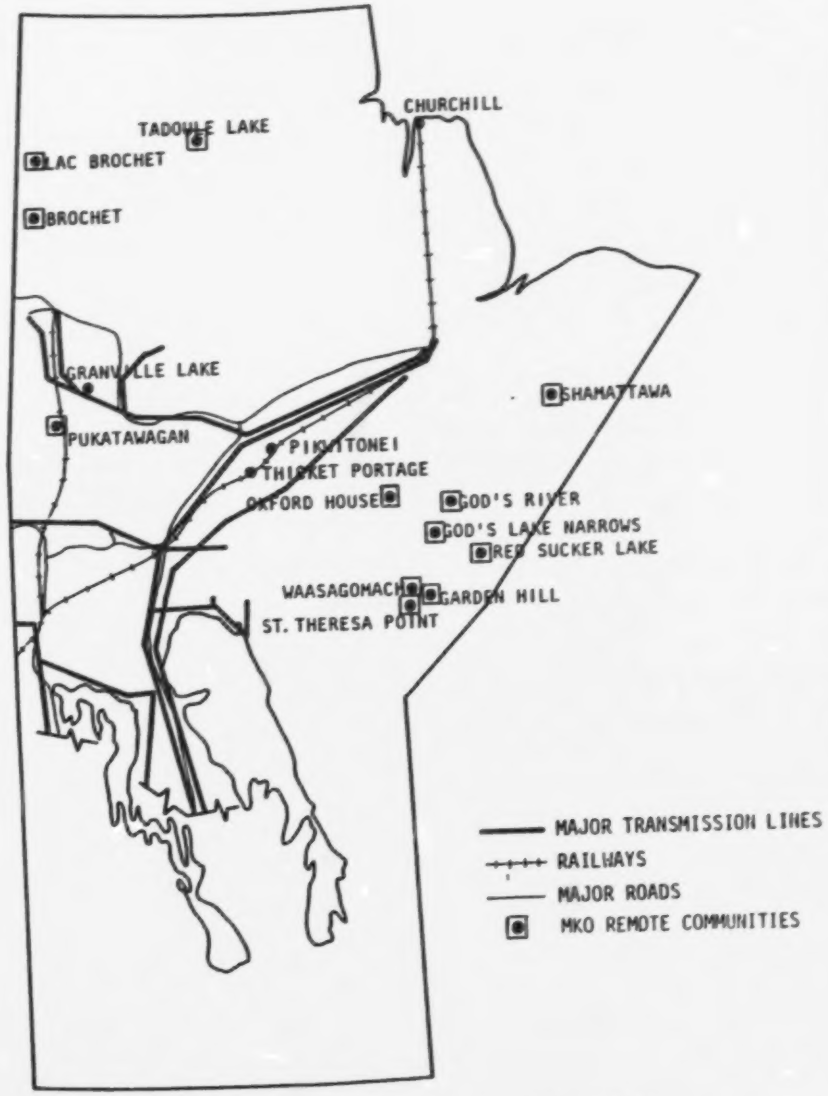

CHURCHILL
TADOULE LAKE
LAC BROCHET
BROCHET
GRANVILLE LAKE
PUKATAWAGAN
PIKWITONEI
THICKET PORTAGE
OXFORD HOUSE
SHAMATTAWA
GOD'S RIVER
GOD'S LAKE NARROWS
RED SUCKER LAKE
WAASAGOMACH
GARDEN HILL
ST. THERESA POINT
MAJOR TRANSMISSION LINES
RAILWAYS
MAJOR ROADS
MKO REMOTE COMMUNITIES

Figure 1.2
Remote Communities Under MKO Jurisdiction

The Remote Community Demonstration Programme (RCDP) is designed to help remote communities in (i.e. those communities off of the main hydro power grid) to conserve energy generally, or specifically to reduce oil consumption. Even though the focus of this project is to design energy efficient remote housing, the Appin/UNIES Design Team had to consider all aspects of housing, including, building layout and structure, as well as the heating system.

Each of the three Phase I stages is discussed in turn.

1.1.1 Background Review Stage

The purpose of the Background Review Stage was to review the administrative/economic, architectural and engineering issues in energy efficient northern housing. The need for such a review was clear. The Appin/UNIES Design Team did not want to develop designs which do not fit with government funding programs. It made no sense to repeat past engineering or architectural design mistakes or not to take advantage of latest advances in housing technology. One needs to build on this previous collective experience. Summarizing this experience in the background review was one way of ensuring that every effort was made to take advantage of previous knowledge. The Design Team made a trip to the communities. The Background Review Stage trip report is attached as Appendix I.

1.1.2 Preliminary Design Stage

In the Preliminary Design Stage, the Design Team developed a number of prototype housing designs heated with wood. The designs were translated into models and architectural sketches. The Design Team produced a series of bungalow, bi-level, 2 storey and modified "A" frame designs (see Figure 1.3). The communities found all but the A-frame to be an acceptable design form. Model wall sections were built to illustrate the construction details. In this way, the designs could be critically reviewed by the communities. A summary of the visit and the response by the community to the designs can be found in Appendix II.

1.1.3 Final Design Stage

Based upon the comments received, the designs would be altered and again in the Final Design Stage presented to the communities. Such an iterative approach, with the communities interacting with the designers, is key to the development of workable housing designs. The final report would include the designs, the construction details, a synopsis of the engineering work to be done, and finally, a set of guidelines for constructing the houses. A summary of the Final Design Stage visit can be found in Appendix III.

1.1.4 Approaches to Phase II

Once Phase I was completed, it was intended to have a second phase whereby the house designs would be built on a demonstration basis in the northern communities. It is also envisioned that local band carpenters would be trained to build the energy efficient housing. Through this multi-phased approach, energy efficient housing would be designed and tested and the skills necessary to build the housing would be transferred to local people in the communities.

1.2 Report Organization

The material in this report is organized into six chapters.

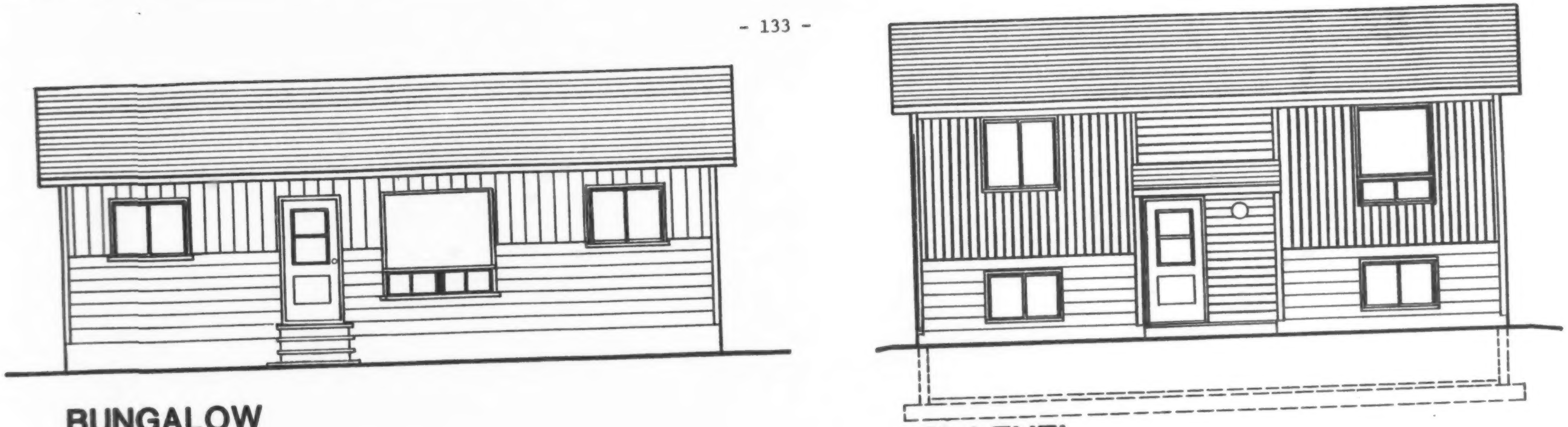
Chapter II is a summary of the Background Review Stage. The full Background Review Stage Report is available as a separate document.

Chapter III outlines the eight bungalow designs developed.

Chapter IV provides the three designs for the bi-level house form.

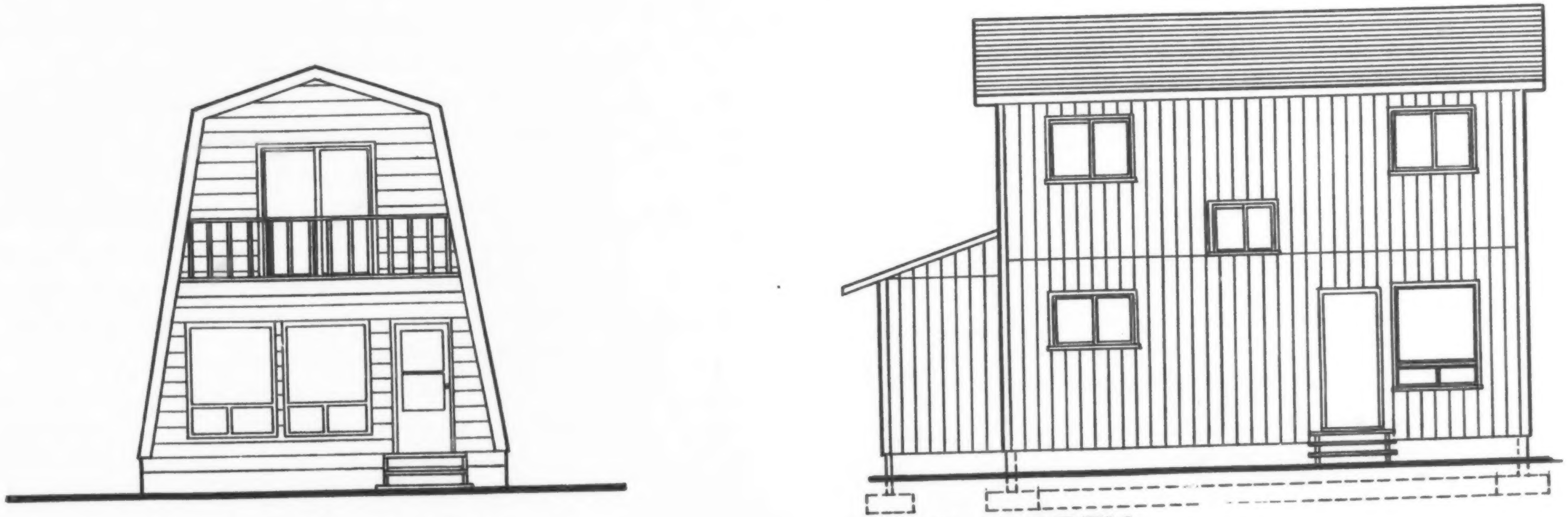
Chapter V details the three designs for the two storey house plans prepared by the Design Team.

Finally, **Chapter VI** provides some conclusions and a brief description of a possible second phase for the project.



BUNGALOW

BI-LEVEL



MODIFIED A-FRAME

TWO STOREY

Figure 1.3

Housing Forms Presented to the Communities

II. A SUMMARY OF THE BACKGROUND REVIEW STAGE

The purpose of the Background Review Stage was to summarize and evaluate previous housing designs for Northern conditions. **It should be noted that the Design Team could not find a similar comprehensive review of previous northern housing designs for Indian People.** The Appin/UNIES Design Team saw the Background Review Stage as an essential step to the development of any housing designs for the Manitoba Keewatinowi Okimakanak Inc. because the Team does not want to repeat past design mistakes nor "re-invent the wheel". **The primary goal of the Design Team was to produce innovative house designs that will meet the needs of Indian people of Northern Manitoba to the greatest extent possible now and in the future.** By working with the four remote communities selected by the MKO, the Design Team strived to maximize satisfaction by the communities with the designs.

The Background Review Stage had three components. They were as follows:

- **An Administrative/Economic Component** which reviewed the capital dollars available and the opportunities for new industry if the new housing were to be built.
- **An Architectural Component** which reviewed past housing designs to determine their good and bad features as well as their applicability to the Design Team's housing design work.
- **An Engineering Component** which summarized the problems and potential solutions for floors, foundations, mechanical systems, etc.

Each of these components is discussed in turn.

2.1 The Administrative/Economic Component

2.1.1 Review of Housing Programs Used in Northern Manitoba

The Design Team reviewed in detail the two major housing programs used to build housing on Indian reserves, namely:

- The DIAND/Band Capital Housing Program.
- The CMHC 56.1 Non-Profit Housing Program.

There are other programs such as the Rural Residential Assistance Program (RRAP) or The Canadian Home Insulation Program (CHIP), but these programs are not used to build new housing. Many Bands use their welfare dollars under the Welfare Operational Program or obtain Canada Works Grants. Both of these programs add labour dollars to the houses, thus leaving more money for buying more building materials.

Under the DIAND Band Capital Housing Program, Bands can build houses on Northern Manitoba reserves that cost up to $44,395 in 1984-5. This maximum value applies to remote reserves such as Tadoule. Reserves with road access or lower transport costs receive less per unit. A Contribution Agreement is signed between DIAND and the Band. DIAND funds the construction and renovation of the houses and the Bands are responsible for building the housing to meet the standards described in Part 9 of the National Building Code.

Housing need in Northern Manitoba reserves is critical. DIAND's own housing needs analysis conducted in 1983-84 showed that the gross backlog on many northern reserves was quite substantial. The current housing needs assessment used by DIAND is based upon a study done in 1977. This study is in the process of being updated at the time of writing this report.

Under the CMHC Section 56.1 Non-Profit Housing Program, Bands can build housing that costs in order of $70,000-$90,000. However, the capital dollars were in the form of a loan, not a grant as in the case of the DIAND Band Capital Housing program. Bands must collect rents from the occupants or use Band funds to pay the monthly costs of operating the house. The loan, however, is given at an effective interest rate of 2% - a rate that is much below market. The Bands use their Capital housing dollars as an equity contribution. Normally, the Bands make equity contributions of approximately $20,000. Thus, a Band can build 2 CMHC houses instead of one DIAND house (cost is approximately $40,000) under the Capital Housing Program.

The house designs must follow CMHC's *Modest Housing Guidelines*. The Design Team's analysis of the guidelines showed that much work has to be done by the designer to justify any new innovative designs. The *Guidelines* also encourage the construction of bi-levels, because they are the most cost-effective. However, bungalows are the most common form of housing in the north. Such a restriction limits design flexibility. Further, cost-effective innovation in design for purposes of the guidelines are evaluated on capital cost savings only, not on capital and operating costs combined. Spending a few more capital dollars to save on energy costs may be hard to justify given the guideline restrictions. The Design Team would argue that innovations which reduce costs in the future should be supported by CMHC. If rent payments are maintained, the mortgages may be paid off faster. In turn, such actions would save CMHC thousands of dollars in annual subsidies required in the future. Thus, the guidelines, while written with the best of intent to ensure that housing is made affordable, may restrict the development of innovative solutions to housing in Northern Manitoba.

The Design Team must develop its house designs within the budgeting and administrative frameworks of the DIAND and CMHC programs because these programs represent the only sources of housing dollars available to the Bands. Designs which cannot meet the conditions of the housing programs will be of little use to Indian people. Thus, the tasks for the Design Team are to develop energy efficient, innovative housing designs which are acceptable to Indian people and, at the same time, can be built under the DIAND and CMHC housing programs.

2.1.2 Analysis of the Economic Benefits of Northern Housing

The Design Team also reviewed the historical information available on the industrial and economic benefits associated with the provision of housing in Northern Manitoba. The results can be summarized as follows:

- **From 1972-75, the Northern Housing Committee developed a "Stackwall" log house that maximized the use of local materials.** Among other problems, the "Stackwall" system was too labour intensive and thus too expensive for use in the north under present housing supply programme guidelines.

- **The Manitoba Government's Remote Housing Program encouraged the development of the ready-to-move housing plants in the north as an alternative to conventional stick built housing.** However, it is difficult to move pre-constructed houses to remote communities. Local people as well do not develop the skills to build housing.

- **The 1976 Northern Manitoba Development Strategy proposed various manufacturing opportunities in the north that would build housing components which maximized the use of local materials.** Sawmills, pulping operations and factories which manufactured doors, windows, trusses, stairs, cabinets, etc. were proposed to be built for various northern communities. However, very few of the Plan's recommendations were implemented.

- **The 1982 Keewatin Tribal Council Northern Economic Conference proposed a strategy which promoted self-sufficiency for Indian Communities.** The plan called for the preparation of an Enterprise Development Plan; the recognition of Thompson as a regional centre; the use of joint ventures between Indian and non Indian Companies; the establishment of a northern banking system and the development of an economic planning capacity on the reserves.

- **Currently housing is supplied through various building supply companies in Manitoba.** All use local labour but few use local materials. The houses are generally of conventional construction.

- **The Canada/Manitoba Northern Development Agreement (NDA) may provide opportunities for greater utilisation of local labour and materials in the construction of northern housing.** Communities have the option under the NDA to apply for funds to build sawmills and kilns and other businesses. There is no overall plan to support local enterprises. Rather, it is up to the communities to submit project proposals.

Overall, it would appear that some effort is being made to maximise the use of local labour and materials in the provision of northern housing. The Design Team must therefore design houses which can be built using local labour wherever possible. This means that the drawings must explain the details of the house in a manner that is clear to local Indian house builders. The designs themselves must also permit the use of local materials such as dimension lumber wherever possible, while at the same time, the designs must meet all building codes.

2.2 Review of Northern Housing From an Architectural Perspective

2.2.1 The List of House Designs Reviewed by the Design Team

In this review of northern residential architecture, studies and examples of house design have been chosen from a number of sources including:

- Province of Manitoba
  - MHRC House Designs
  - J. Pass Designs
  - K. Nimpuno Designs

- CMHC House Designs
  - Kennedy/Smith Designs
  - Crofter House Designs

- DIAND House Designs
  - The ID House Designs
  - The RD House Designs
  - B. Chill House Designs

- Quebec/Naskapi House Designs
  - Quebec Indian House Designs
  - Naskapi House Designs

- Arctic Housing Designs
  - J. Ross Designs
  - Hia Toh Lim House Designs
  - Allen/Drerup/White House
  - S. Fancott House Design
  - Shelter Corp. "Igloo" House Design

- Log Housing
  - Conventional log housing
  - "Stackwall" housing

- Designs Currently used in Northern Manitoba
  - McMunn & Yates House Designs
  - Norseman Enterprises Ltd. Designs
  - Island Lake Tribal Council Designs

While not an exhaustive review of all the material available pertaining to the complex topic of remote house design, the designs chosen are meant to provide a cross section of the work which has been completed to date. Each design is evaluated according to its functional considerations (space allocation and relationships), its social aspects (suitability to the 'northern lifestyle'), building system or construction method (complexity, innovation, etc.) and its mechanical systems (heating, ventilating and waste disposal).

2.2.2 Lessons Learned from the Architectural Review

The Design Team has learned a number of lessons by conducting this architectural review. The key points that should be considered in future designs to be prepared by the Design Team can be summarized as follows:

- The majority of houses built in northern Manitoba have not been designed nor adequately constructed for the harsh northern conditions.

- The typical three bedroom bungalow plans with hallways and all the bedrooms at one end of the house do not meet all the living requirements of Indian families. This is evident in the poor heat distribution from central wood heaters in these house layouts. A variety of housing sizes and types should be considered so as to accommodate the needs of large and small families as well as the elderly. Other housing forms such as the bi-level or one and one half or two storey houses may meet needs in a more cost effective manner.

- The budgetary allowances available under the DIAND Capital Housing Program appear to be inadequate to provide comfortable family housing. **Adding in energy conserving and other features into the designs is more difficult given the constraints imposed by the current budgets.** This budgetary constraint forced the Design Team to drop the reliance upon the Arctic Housing Standards as a design guideline.

- The Design Team notes that architectural and engineering design guidelines developed on 1967 by Kennedy/Smith Associates are still valid today.

- Yet, the Design Team believes that many of the designs reviewed would be considered to be quite unsophisticated by Indian people today.

2.2.3 Summary of the Architectural Major Design Considerations for this Design Project

The Design Team has identified a number of issues that must be addressed in the designs including the following:

- The Team must design houses which give the feeling of spaciousness. This can be done by limiting the use of partitions and possibly by using high ceilings.

- While the bungalow is the dominant house type, there is a need to offer a range of housing forms and sizes to accommodate the variations in family housing needs.

- There is a requirement to provide vestibules or protected entrances so as to reduce drafts in the house.

- The bathroom must be located close to the exit of the house to provide for maximum sanitary conditions where the "honey bucket" system is used.

- There is a need to provide for proper air circulation so that heat is adequately distributed throughout the house. At the same time, ventilation systems must be quiet and must operate with little requirement for adjustment by the occupant.

- Built-in furniture may help improve the living environment as well as save the occupant housing costs.

- The houses need adequate storage spaces as well space for working on equipment or skinning animals.

2.3 Summary of the Engineering Design Considerations for Northern Housing

Using relevant codes, standards, studies and personal observation, the engineering chapter reviews current construction practices in the study communities on a component by component (e.g. foundations, etc.) basis. Construction related problems were examined in detail, particularly those which affect the energy and structural performance of the house. **Finally, possible solutions were identified and evaluated relative to the needs of the people and the physical environment of the communities.** Considering the very real and practical problems of the north (budget constraints, climate, lifestyle, limited availability of trade skills and transportation problems) its housing problems are best addressed by applying proven design concepts, not radical departures from conventional practices. The following is a summary of the recommendations and conclusions for the various engineering components of northern housing. The Design Team would note that not all of these recommendations may be possible within the existing budgets. Thus, priorities must be set and trade-offs, where necessary, may need to be made.

2.3.1 Foundations

Variations in soil conditions, house styles and materials costs in the Study Communities make it impossible to identify a single "best" foundation design for northern housing. Design considerations include the following:

- Where settling or heaving are problems, eliminate the central beam by using pre-fabricated, clear span floor joists or trusses.

- Where soil erosion is a problem, avoid building sites on hills or along drainage routes.

- Install polyethylene ground sheets under all crawl spaces to control ground source moisture problems.

- Except on permafrost, insulate around the perimeter of foundations to prevent the crawl spaces from freezing.

- Vent crawl spaces in summer to dry them.

2.3.2 Floor Systems

This includes floor trusses or joists, decking, floor covering, in floor insulation and vapour barrier. The recommendations of the Design Team include:

- Sheet flooring is recommended, especially at entrances, because of its resistance to damage from standing water.
- Wood stoves should sit on a fireproofed, insulated pad.

2.3.3 Exterior Walls

Several wall configurations have been developed for energy efficient housing. Six of these were evaluated with respect to their ease of construction, energy efficiency and structural durability. The Design Team would make the following recommendations on wall systems:

- The standard 2" x 6" R 20 frame wall should be used for small houses.
- Larger houses should be constructed using 2" x 6" frame walls with interior and/or exterior strapping or exterior insulated sheathing for increased energy efficiency.
- Airtight house construction techniques should be applied, including using 6 mil polyethylene air/vapour barrier sealed with acoustical sealant.
- Use thicker (sturdier) interior wall cladding.
- Replace fiberboard cladding with 3/8" (10 mm) waferboard (eg. "Aspenite") for increased strength.
- Replace standard building paper with "Tyvek" because it is a more effective air barrier.
- Use durable trim on exterior corners and around windows and doors.

2.3.4 Windows

Windows are psychologically important in housing in extremely cold climates. In houses with wood heat, windows are also required as fire exits. Design considerations for windows include the following:

- New housing should have triple glazed windows with at least 1/2" (13 mm) air spaces between the panes.
- Operating windows should have high quality weatherstripping.
- Use non-operating windows wherever possible as these are more energy efficient and durable. Provide screened vent doors over windows where required.
- Orient houses to maximize south facing windows and minimize north facing windows.
- Specify heavy duty hardware for operating windows.
- Consider the use of "Lexan" plastic storm windows because of their durability.

2.3.5 Exterior Doors

Snow hinging and cold weather failure of weatherstripping are common problems associated with doors in northern housing. Strategies for resolving exterior door problems include:

- Use insulated steel doors for increased durability and reduced energy loss.

- Double weatherstrip doors to reduce air leakage.

- Use four heavy 4-screw hinges with 3" (76 mm) screws to reduce door hinge failure.

- Build porches at main entrances to reduce energy loss and snow accumulation in the doorways.

- Install restraining hardware and padded stops on outside opening doors.

- Use heavier hinge side door frames.

- Use lever type openers with D-ring handles, as these are easy to operate when wearing mitts.

- Use face mounted threshold seals.

- Use "Lexan" plastic windows in storm doors for durability.

- Ultimately, develop a freezer type exterior door which closes over, and not into the door opening, so as to solve the problems common to conventional exterior doors used in northern situations.

2.3.6 Ceilings and Roofs

The major problems result from water damage to the ceiling caused by air exfiltration into the attic from the living space and by wind-borne snow being blown into the attic. Recommendations for ceilings and roofs include:

- Attics should be insulated to R 50 to R 60 (RSI 8.81 to 10.57) with even coverage and adequate clearance around chimneys.

- The ceiling air/vapour barrier should be constructed from continuous 6 mil polyethylene properly sealed at all joints with acoustic sealant to control air leakage. Particular attention should be paid to stopping air leakage through partition walls and where wiring penetrates the ceiling.

- The ceiling should be completed before the interior partitions are installed. This facilitates using a continuous air/vapour barrier in the ceiling.

- High heel trusses should be used to allow extra insulation at the ends of the trusses.

- Precautions should be taken to minimize truss uplift problems.

2.3.7 Heating and Ventilation

The greatest opportunities to improve the quality of housing in the communities lie with upgrading the heating and ventilation systems. Significant improvements in safety, heating system efficiency and comfort are all possible if the following recommendations are considered:

- Airtight wood stoves with internal baffles and combustion air controls should be used in place of the 45 gallon or oval-type sheet metal stoves.

- All relevant standards dealing with the acceptability of wood stoves, their installation, maintenance and inspection should be closely followed.

- Type M chimneys should be used instead of Type A vents for safety reasons.
- Seasoned rather than green firewood should be used to improve the heating system efficiency and to reduce the fire risk due to creosote formation in the chimney.
- The possibility of using some simple type of air distribution system to move heat from the stove through the house should be explored.

2.3.8 Water Supply and Waste Disposal Systems

Available services in most of the northern communities are poor at best and even primitive in some cases. Aside from being uncomfortable for the people, the poor quality of water supply and waste disposal services represents a significant public health risk. The Design Team would make the following observations:

- Where an indoor "honey" bucket system is used, the washroom should be located to allow easy disposal of the waste without carrying it through other areas of the house.
- Alternative toilet systems such as the mechanical seal and composting toilets should be considered for eventual use.
- If residential water use increases in the future, more formalized water disposal systems will have to be employed to prevent environmental problems (eg. groundwater polution) in the communities.
- House designs should include provision for water storage tanks even if trucked or well water is not currently available.
- Alternative community sewage treatment systems need to be explored in greater depth.

2.3.9 Electrical Systems

The limitations of 15 amp service continue to pose a frustrating obstacle to the people of the Study Communities which will be eliminated only by connecting into the Manitoba Hydro electrical grid. However, the existing electrical services can be designed to minimize problems with other aspects of the house design if the following items are given serious consideration:

- In houses with insulated crawl spaces, wiring can be run in the crawl space to minimize penetrations through the ceiling.
- If strapped exterior wall systems or double wall systems are used, wiring can be routed inside the air/vapour barrier, minimizing air leakage problems caused by penetrations through the air/vapour barrier.
- For this same reason, wiring can be routed along walls, through wiring chases or in conduit baseboards.

2.4 Concluding Remarks

As can be expected, there is not one ideal solution to dealing with remote northern housing. It is intended that the designs developed will address the issues and problems that have been identified by incorporating already proven ideas.

These design considerations will lead to design trade-offs and compromises. These must be discussed thoroughly with the people in the communities of Brochet, Lac Brochet, Pukatawagan and Tadoule Lake, as well as with key people in the MKO, the Tribal Councils and Government so that their specific concerns can be respected and satisfied.

The detailed Table of Contents of the Background Review Report can be found in Appendix IV.

III. BUNGALOW DESIGNS

The bungalow house form is the most common type of house built in Northern Manitoba. The Design Team developed 8 designs which are as follows:

1. 24' x 36' Plan "A" (3 br)
2. 24' x 36' Plan "B" (4 br)
3. 24' x 36' Plan "C" (3 br)
4. 24' x 28' Plan "A" (2 br)
5. 24' x 28' Plan "B" (2 br)
6. 24' x 28' Plan "C" (3 br)
7. 24' x 32' (3 br)
8. 24' x 40' (4 br)

The floor plans and elevations of each of the designs is shown in turn. The complete set of drawings for the 24' x 36' Plan "A" is shown for illustrative purposes. For more detailed information, readers are referred to the construction drawings under separate cover. The next section outlines the engineering features for the bungalows. It should be noted that it would be possible to mix some aspects of each plan to form a new unique solution. For example, using Plan "A" three bedroom design one could remove the current bedroom and bathroom (on the right side of the plan) arrangement and replace it with the arrangement used in Plan "B".

3.1 Engineering Design Considerations and Solutions for the Bungalow Designs

Component	Problem	Proposed Solution
Foundation	Variations in soil conditions, house styles and materials costs between communities make it impossible to identify a single "best" foundation design for northern housing. Settling and heaving of foundations in some communities causes structural damage to the houses. high humidity in crawl spaces causes deterioration of floor system.	A variety of foundation designs were prepared, making it possible for the builder to choose the most economical foundation for each project. Any of the house designs can be built using clear span, prefabricated floor trusses. All plans specify 6 mil poly ground sheets under crawl spaces to control ground source moisture problems. Crawl spaces have vents designed to be opened in the summer to air dry the crawl space.
Floor System	Floor tiles, especially at entrances, lift off. Floors are cold.	Use of sheet flooring is recommended. Heated crawl spaces with insulated walls are recommended.
Exterior Walls	The climate in the north dictates that the house exterior walls have high insulation levels and be of airtight construction. Finishes must be study. Construction must be simple and straightforward, reflecting the manpower, equipment and financial constraints common to native housing projects.	All exterior walls are 2 x 6 frame construction, cross strapped with 2 x 2's on the interior. The vapour barrier is located between the 2 x 6 and 2 x 2 framing. The entire wall cavity is filled with with insulation, yielding R-25 walls with only minimal amounts of thermal bridging. Wiring in outside walls is located completely inside the vapour barrier reducing the number of perforations in the vapour barrier. Heavier exterior cladding than those currently used are recommended. Wall construction is simple, and not much diffierent than is currently being built in the native communities.
Windows	Windows are a major source of heat loss in northern housing. This is due to air leakage around the window frame and within the window unit.	Non operating windows are specified wherever possible. The size of operating windows is minimized. "Lexan" plastic windows are not recommended because they may prevent windows from serving as an exit in event of a fire.
Exterior Doors	Snow hinging and cold weather failure of weatherstripping are common problems.	It is recommended that insulated steel exterior doors be used. Doors to be double weatherstripped. Use four 4-screw door hinges with 3" long screws which screw through into the framing around the rough opening. An attached porch detail is included with most house plans. Porches reduce snow accumulation on door jambs and threshholds.

Component	Problem	Proposed Solution
	Doors are hard to open when wearing mitts.	Lever type openers with D-ring handles are recommended.
Ceilings and Roofs	Moisture accumulation in attics is a major cause of ceiling damage.	Specifications call for a continuous 6 mil poly vapour barrier sealed at all seams and penetrations in the ceiling. The vapour barrier and ceiling finish are to be installed prior to placement of interior partitions. Raised heel trusses are specified. An insulation retainer and wind shield minimizies the amount of snow blowing in the soffits and into the insulation. It also helps keep outside ceiling corners warm, reducing condensation problems. The designs minimize the number of ceiling mounted electrical fixtures, thus the number of penetrations in the ceiling vapour barrier.
Heating and Ventilation	Fire safety is a significant concern wherever wood heating is used.	Well constructed, airtight wood stoves with brick liners are specified. All stoves to be mounted on non combustible surfaces and adjacent walls are protected by metal shielding conforming to CSA Can 3-B365-M84. Where closer clearances to walls are required, shielded stoves are specified. Type M, high temperature chimneys are specified.
	An outside air supply is required for combustion appliances in energy efficient houses. Ventilation air is required to control indoor humidity. Mechanical ventilation is impractical in housing equipped with 15 amp service. Cold ventilation air must not reduce occupant comfort, or attempts may be made to block the fresh air inlet. This could cause stove backdrafting, and create a health hazard due to smoke or carbon monoxide build-up in the house.	An outside air supply duct has been designed to introduce fresh air through the wall behind the heat shielding near the stove. The fresh air will be warmed by the shield, and will mix with house air, providing ventilation for occupant comfort. This fresh air inlet location greatly reduces the likelihood of the occupant blocking off the inlet. The stove draws combustion air from the space around it, thus removing stale air and humidity from the house.
	Moving heat from the stove to the far reaches of the house is difficult without the use of fans and ductwork.	High wall grilles allow warm air to circulate into closed rooms. Undercutting doors allows cool air to flow out of rooms.

Component	Problem	Proposed Solution
	Heating the crawl space is a problem because heat rises from the stove and thermal stratification, inhibits air movement from the house into the crawl space.	Floor grilles near the back of the wood heater will encourage air to convect up past the wood stove. Floor grilles around the perimeter of the house will allow house air to flow down into the crawl space warming it slightly. This, combined with radiant and conductive heat flow from the floor should maintain acceptable temperatures in the crawl space.
Water Supply and Waste Disposal Systems	If indoor plumbing services or trucked water systems are introduced to the community, conversion of existing housing stock to benefit from these systems is difficult.	Many of the house designs have areas that are well suited for locating water storage tanks. Where practical, washrooms and kitchens are located back to back, to facilitate joint plumbing. Heated crawl spaces make servicing from the crawl space feasible. The Background Review Report identified a design in which a mechanical seal toilet in an upper level washroom can flush to a waste bucket located outside the house.
Electrical Systems	Wiring in conventional housing results in numerous perforations in the poly vapour barrier.	All wiring is to be done from the crawl space (unless the floor system is insulated and the crawl space is unheated) thus reducing penetrations through the ceiling vapour barrier. As much as possible wiring should be done on interior paritions. The vapour barrier on outside walls is set back sufficiently into the wall to allow all wiring to be run inside the vapour barrier.

3.2 24' x 36' Bungalow Plans

There is approximately 864 sq. ft. of useable floor area in each design. The design features for each plan is outlined below.

3.2.1 Plan "A" (3 bedroom version) Design Features

- The vestibule entry can be accommodated at the rear (kitchen) entrance by either the addition of an enclosed porch, or by extending the closet a short distance to form a vestibule (minimum 3'-6" deep) and by adding a door at its end to complete the double door airlock.

- A secondary exit for use during the summer or for emergencies (i.e. fire) has been provided from the living room.

- In this plan - neither storage or utility space has been specifically allotted, but there is an approximate total of 58 sq. ft. of closet space provided.

- Separation between public and private areas is minimal in that the Design Team wanted to provide the maximum amount of usable floor area as feasible (i.e. minimizing the use of hallways). **The Bands suggested that they would rather have more living space than maximizing privacy.**

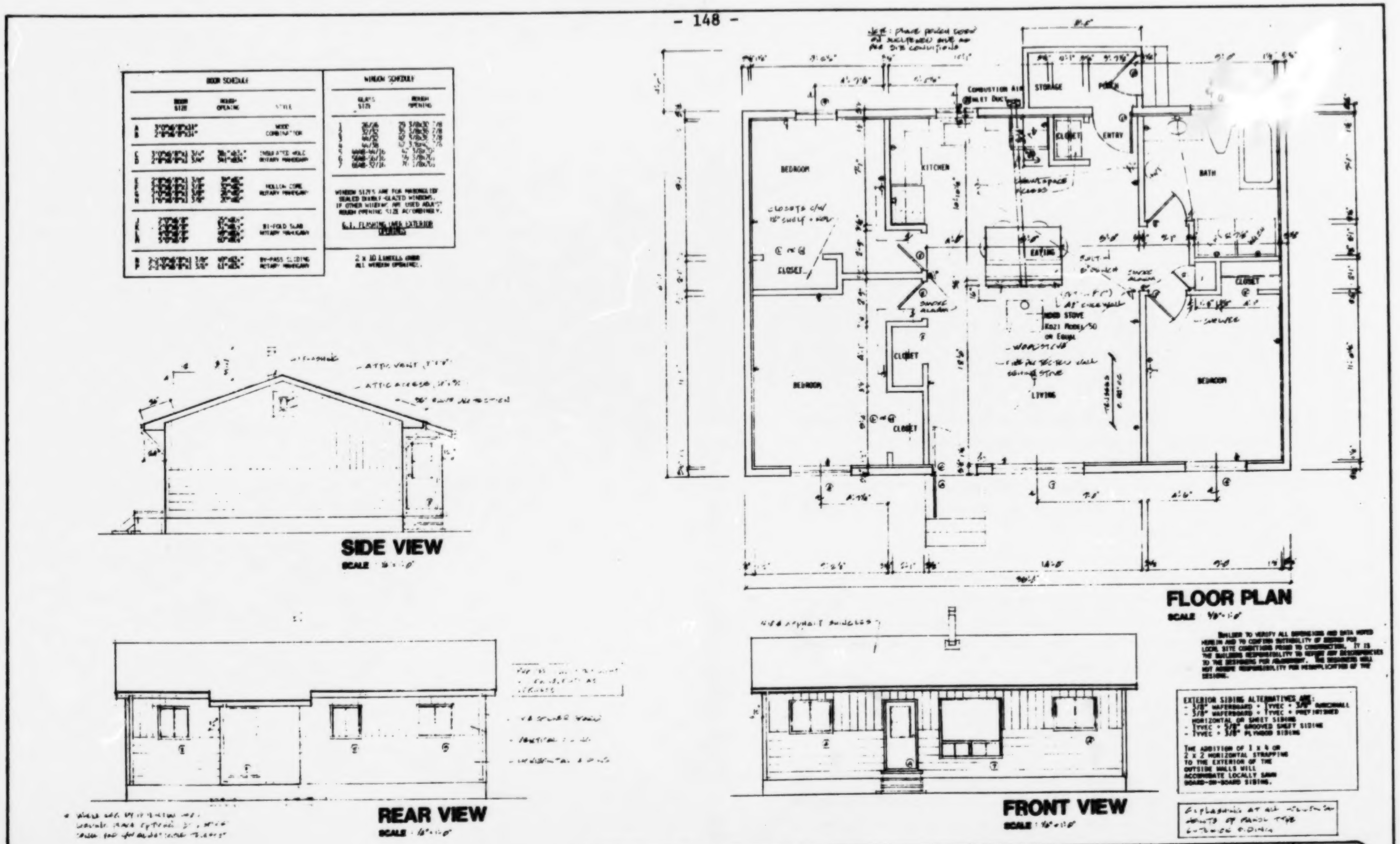
- There is an open plan style along central portion of house to help provide feeling of spaciousness.

- The wood stove has been centrally located to help provide adequate heat distribution, and to provide a physical separation (along with the kneewall behind it) between the differing functions taking place within this central core.

- A built-in bench seat has been added (opposite side from stove) using the kneewall as a backrest, for seating at the dining table.

- The centralized location of the stove also lends to its use as a cooking surface. (Note that heat distribution may be a problem if doors to the bedrooms are always shut, thus reducing heat flow into the rooms.)

- The bathroom is located close to the rear exit from the house, facilitating the use of the "honey bucket" system.


DOOR SCHEDULE
WINDOW SCHEDULE
COMBUSTION AIR INLET DUCT
STORAGE
PORCH
CLOSET
ENTRY
BEDROOM
KITCHEN
EATING
BATH
CLOSET
WOOD STOVE
LIVING
BEDROOM
CLOSET
BEDROOM
CLOSET
SMOKE ALARM
SIDE VIEW
SCALE
REAR VIEW
SCALE
FRONT VIEW
SCALE
FLOOR PLAN
SCALE 1/8"=1'-0"

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" WAFERBOARD + TYVEC + 3/8" [illegible]
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

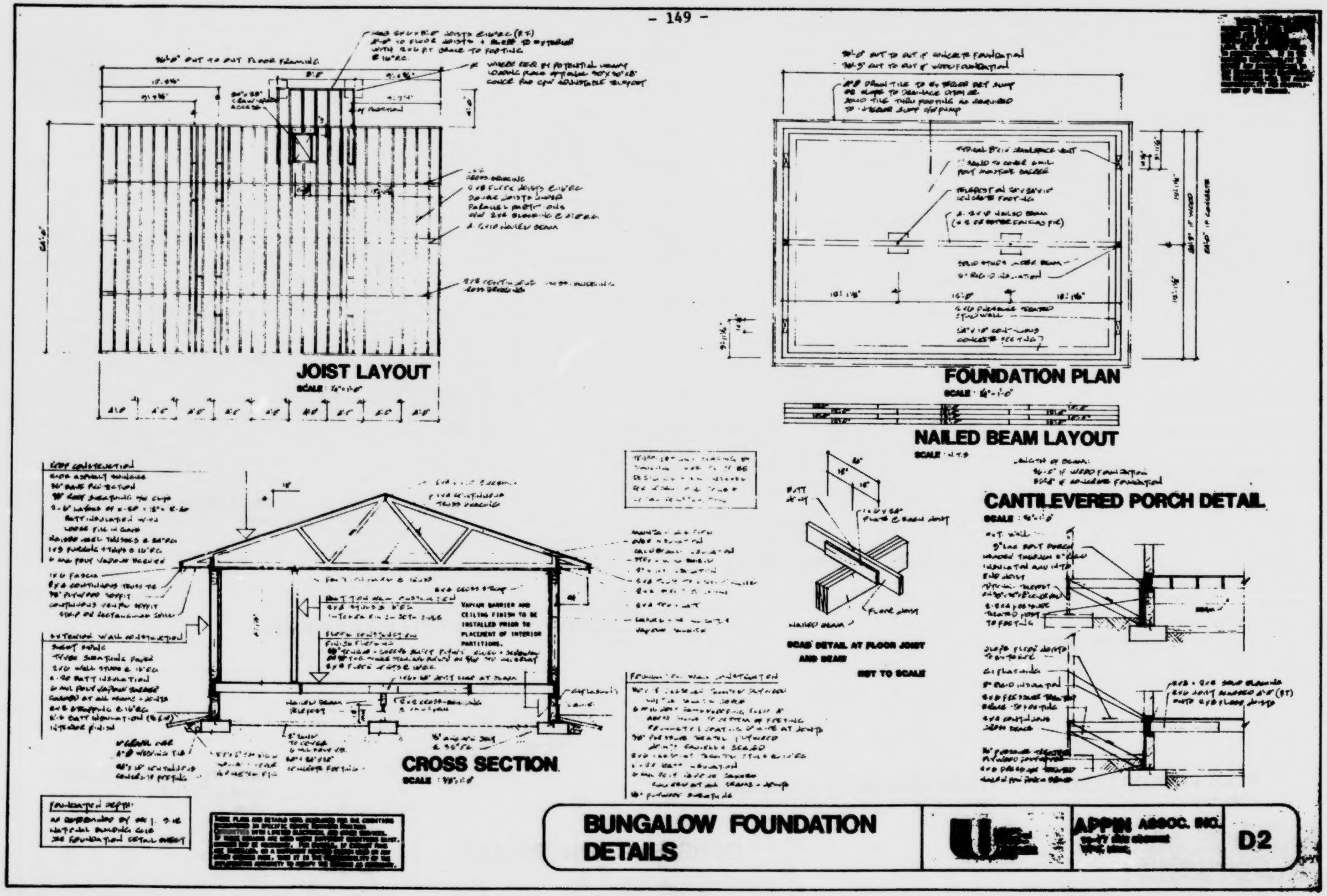
THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

Ex flashing at all horizontal joints of panel type exterior siding

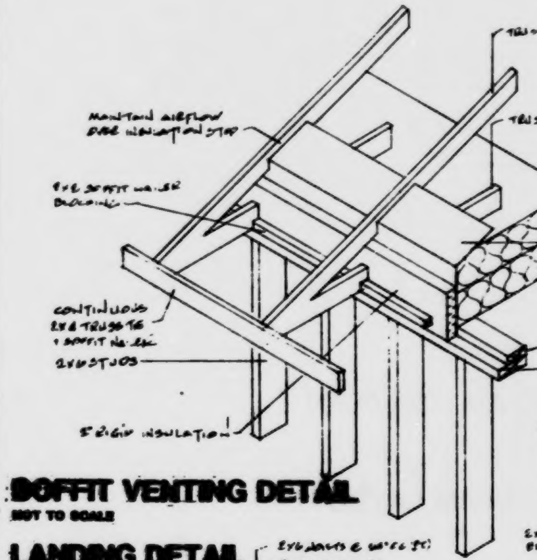
24 x 36 BUNGALOW
3 BEDROOM

APPIN ASSOC. INC.
19-77 [illegible]
WPG. MAN.

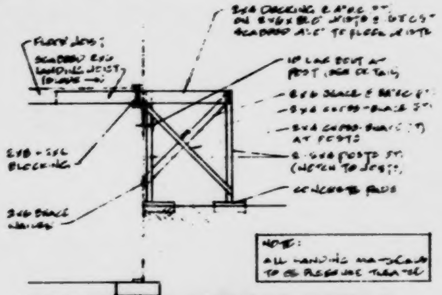
D1


JOIST LAYOUT
SCALE
FOUNDATION PLAN
SCALE
NAILED BEAM LAYOUT
SCALE
CANTILEVERED PORCH DETAIL
SCALE
CROSS SECTION
SCALE
SCAB DETAIL AT FLOOR JOIST AND BEAM
NOT TO SCALE
VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.
BUNGALOW FOUNDATION DETAILS
APPIN ASSOC. INC.
D2

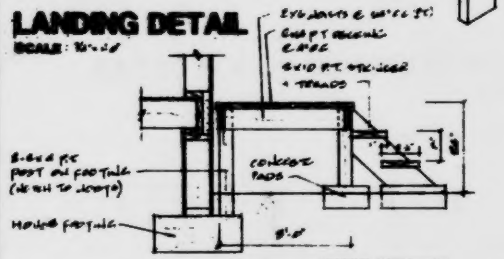
[illegible]


TRUSS TOP CHORD
MAINTAIN AIRFLOW OVER INSULATION STOP
TRUSS BOTTOM CHORD
2x2 SOFFIT NAILER BLOCKING
12" (MIN)
CARDBOARD INSULATION STOP + WIND SHIELD
2 - 6" (R-20) LAYERS OF BATT INSULATION TOTAL EQUALS 12" (R-40)
CONTINUOUS 2x4 TRUSS TIE + SOFFIT NAILER
2x4 TOP PLATE
2x6 STUDS
2x6 PLATE
2" RIGID INSULATION

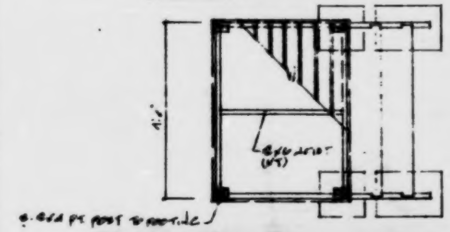
BOFFIT VENTING DETAIL
NOT TO SCALE


2x6 DECKING @ 24" O.C. ON 2x6 x 8'-0" JOISTS @ 24" O.C. SCABBED ALSO TO FLOOR JOISTS
FLOOR JOIST; SCABBED 2x6 LANDING JOIST
1/2" LAG BOLT AT POST (SEE DETAIL)
2x6 BRACE @ 24" O.C.
2x4 CROSS-BRACE
2x4 CROSS-BRACE AT POSTS
2 - 4x4 POSTS P.T. (NOTCH TO JOISTS)
2x8 + 2x6 BLOCKING
2x6 BRACE
CONCRETE PADS
NOTE: ALL LANDING MATERIAL TO BE PRESSURE TREATED

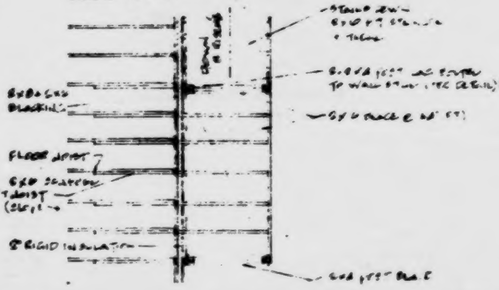
LANDING DETAIL
SCALE: ½"=1'-0"


2x6 JOISTS @ 24" O.C. P.T.
2x6 P.T. DECKING EDGE
2x10 P.T. STRINGER + TREADS
2-4x4 P.T. POST ON FOOTING (NOTCH TO JOISTS)
CONCRETE PADS
HOUSE FOOTING
8'-0"

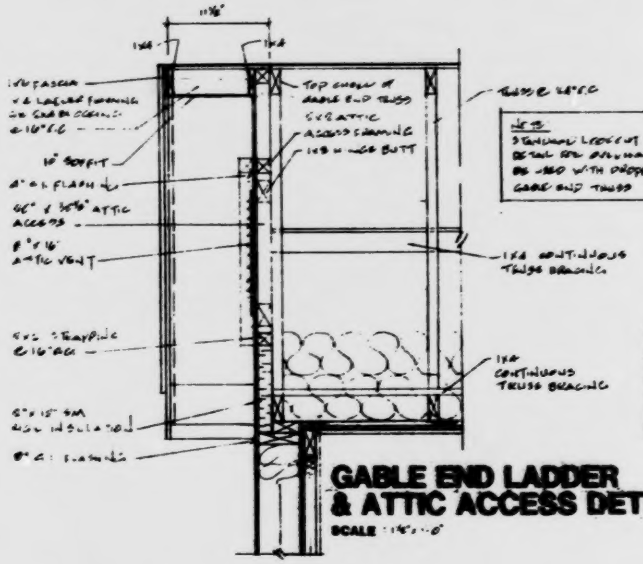
BI-LEVEL LANDING DETAIL
SCALE: ⅛"=1'-0"


4'-0"
2x6 JOIST (P.T.)
4-4x4 P.T. POST TO FOOTING

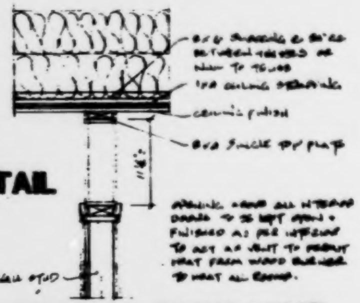
PLAN VIEW OF LANDING
SCALE: ½"=1'-0"


STAIR DOWN 2x10 P.T. STRINGER + TREADS
2x6 & 2x6 BLOCKING
2-4x4 POST LAG BOLTED TO WALL STUD (SEE DETAIL) P.T.
2x6 BRACE @ 24" P.T.
FLOOR JOIST
2x6 SCABBED P.T. JOIST
2" RIGID INSULATION
2x4 POST BRACE

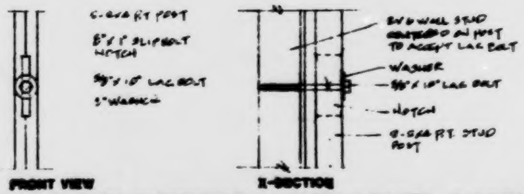
PLAN VIEW OF BI-LEVEL LANDING
SCALE: ⅛"=1'-0"


11⅜"
1x4
1x4
1x6 FASCIA
1x4 LADDER FRAMING ON GABLE ENDS @ 16" O.C.
TOP CHORD OF GABLE END TRUSS
2x2 ATTIC ACCESS FRAMING
1x3 HINGE BUTT
TRUSS @ 24" O.C.
NOTE: STANDARD LOOKOUT LADDER DETAIL FOR OVERHANG MAY BE USED WITH DROPPED GABLE END TRUSS
16" SOFFIT
2" O.L. FLASHING
22" x 30" ATTIC ACCESS
8" x 16" ATTIC VENT
1x4 CONTINUOUS TRUSS BRACING
2x2 STRAPPING @ 16" O.C.
1x4 CONTINUOUS TRUSS BRACING
2" x 12" SM RIGID INSULATION
8" O.L. FLASHING

GABLE END LADDER & ATTIC ACCESS DETAIL
SCALE: ¼"=1'-0"

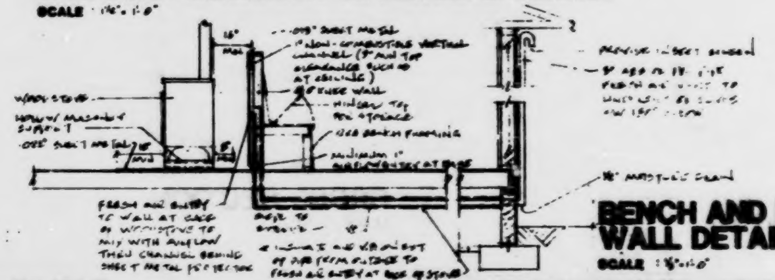

2x6 BLOCKING @ 24" O.C. BETWEEN TRUSSES OR NAIL TO TRUSS
1x4 CEILING STRAPPING
CEILING FINISH
2x4 SINGLE TOP PLATE
11⅜"
OPENING ABOVE ALL INTERIOR DOORS TO BE LEFT OPEN + FINISHED AS PER INTERIOR TO ACT AS VENT TO PERMIT HEAT FROM WOOD BURNER TO HEAT ALL ROOMS.
WALL STUD

INTERIOR ROOM VENT
SCALE: ¼"=1'-0"


2-4x4 P.T. POST
8" x 1" SLIP BOLT NOTCH
⅝" x 10" LAG BOLT
2" WASHER
2x6 WALL STUD CENTERED ON POST TO ACCEPT LAG BOLT
WASHER
⅝" x 10" LAG BOLT
NOTCH
2-4x4 P.T. STUD POST

FRONT VIEW X-SECTION

LAG BOLT DETAIL AT BI-LEVEL LANDING
SCALE: ¼"=1'-0"


16" MIN
.019" SHEET METAL
1" NON-COMBUSTIBLE VERTICAL CHANNEL (8" AND TOP CLEARANCE SUCH AS AT CEILING)
2x4 KNEE WALL
HINGED TOP FOR STORAGE
2x2 BENCH FRAMING
MINIMUM 1" CLEARANCE AT BASE
WOOD STOVE
HEARTH/ MASONRY SUPPORT
.019" SHEET METAL
FRESH AIR ENTRY TO WALL AT CASE OF WOODSTOVE TO MIX WITH AIRFLOW THEN CHANNEL BEHIND SHEET METAL PROTECTION
PIPE TO OUTSIDE
4" INSULATED AND VAPOR PROOF DUCT OF AIR FROM OUTSIDE TO FRESH AIR ENTRY AT BASE OF STOVE
PROVIDE INSECT SCREEN
4" ABS OR PVC PIPE FRESH AIR INLET TO BE SLOPED AWAY FROM STOVE
½" MASTIC SEAL

BENCH AND FIREGUARD WALL DETAIL
SCALE: ⅛"=1'-0"

[illegible]

CONSTRUCTION DETAILS

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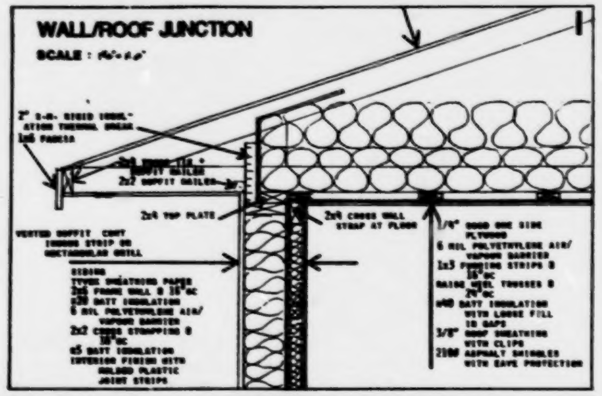
3


1
2" S-R- RIGID INSUL- ATION THERMAL BREAK
1x6 FASCIA
2x2 SOFFIT NAILER
2x4 TOP PLATE
VENTED SOFFIT CONT. SCREEN STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
2x4 CROSS WALL STRAP AT FLOOR
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" OC
RAISED HEEL TRUSSES @ 24" OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION

WALL/ROOF JUNCTION

SCALE : 1½" = 1'-0"

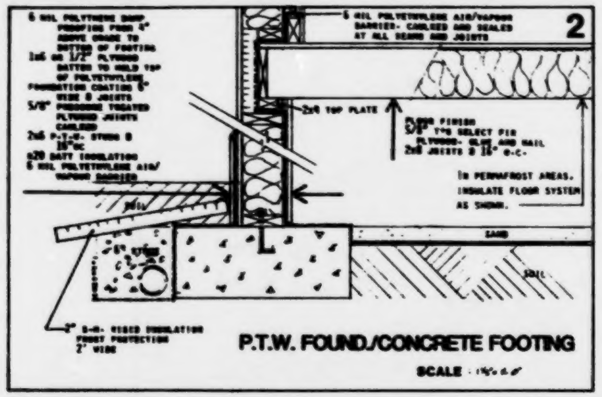
1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATHING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 x 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR THE JUNCTION BETWEEN THE FIRST FLOOR AND A PRESERVED WOOD FOUNDATION. AFTER THE FOUNDATION WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL. THE REMAINDER HANGS DOWN ON THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL IS PLACED ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

3 FRAME WALL OVERHANGS JOIST HEADER AND CONCRETE CRAWL SPACE WALL BY 2". 6 MIL POLY VAPOUR BARRIER RUNS UNDER BOTTOM PLATE OF FRAME WALL AND ON THE CRAWL SPACE WALL TO THE FOOTING. 2" OF RIGID INSULATION IS PLACED OVER THE VAPOUR BARRIER. DO NOT INSULATE INSIDE OF JOIST HEADER. AT FOOTING, RIGID INSULATION IS EXTENDED HORIZONTALLY 2 FEET TO PROVIDE A THERMAL BREAK. GROUNDSHEET IN CRAWL SPACE IS REQUIRED FOR MOISTURE CONTROL. IT IS HELD IN PLACE AND PROTECTED BY A LAYER OF SAND OR FINE SOIL.

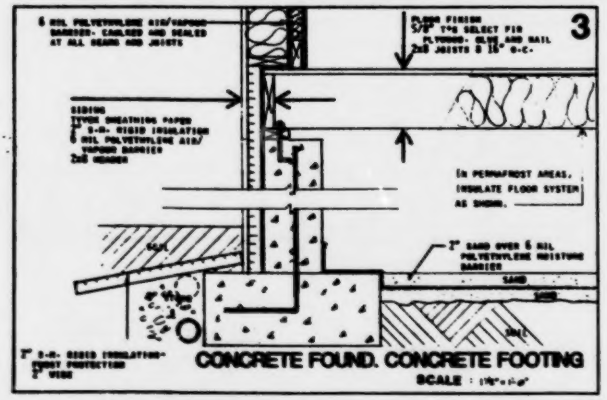
UNHEATED CRAWL SPACE IS ONLY RECOMMENDED WHERE HOUSE IS LOCATED ON PERMAFROST. THE PLYWOOD FLOOR SHEATHING SERVES AS THE FLOOR VAPOUR BARRIER. CAULK THE WALL VAPOUR BARRIER TO THE FLOOR SHEATHING AND CAULK THE SEAMS BETWEEN THE SHEETS OF PLYWOOD. A 6 MIL POLY GROUNDSHEET IS LOCATED UNDER THE HOUSE AND PROTECTED WITH A LAYER OF SAND.

THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).


2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
SAND
6" STONE
2" S-R- RIGID INSULATION FROST PROTECTION 2' WIDE

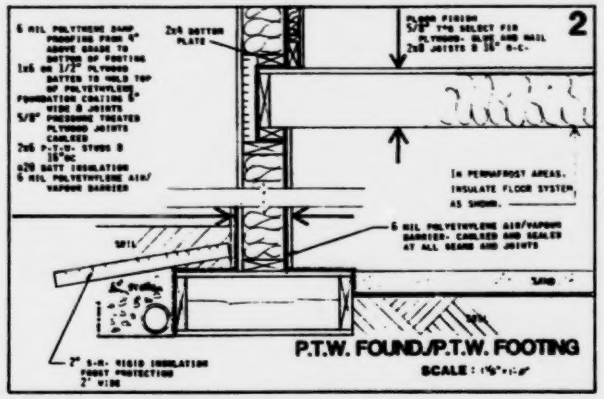
P.T.W. FOUND./CONCRETE FOOTING

SCALE : 1½" = 1'-0"


3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
SIDING
TYVEK SHEATHING PAPER
2" S-R- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SOIL
2" S-R- RIGID INSULATION- FROST PROTECTION 2' WIDE

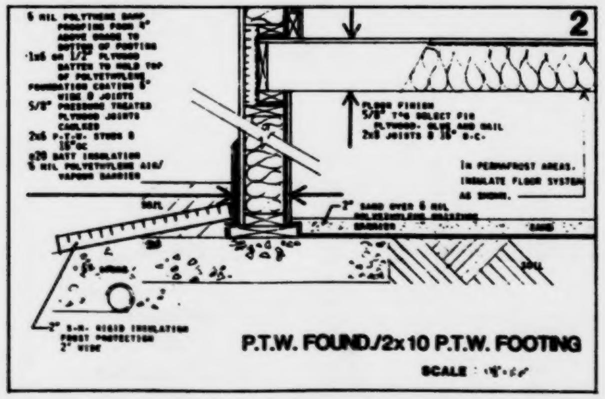
CONCRETE FOUND. CONCRETE FOOTING

SCALE : 1½" = 1'-0"


2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x4 BOTTOM PLATE
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SOIL
SAND
2" S-R- RIGID INSULATION FROST PROTECTION 2' WIDE

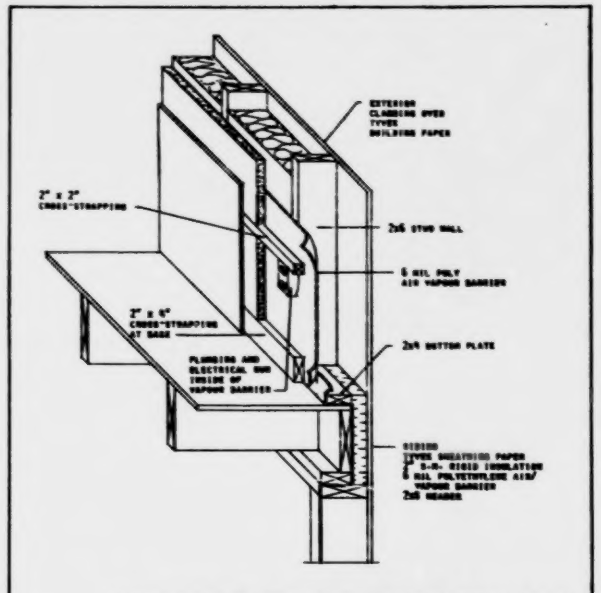
P.T.W. FOUND./P.T.W. FOOTING

SCALE : 1½" = 1'-0"


2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
2" SAND OVER 6 MIL POLYETHYLENE BARRIER
SAND
SOIL
2" S-R- RIGID INSULATION FROST PROTECTION 2' WIDE

P.T.W. FOUND./2x10 P.T.W. FOOTING

SCALE : 1½" = 1'-0"

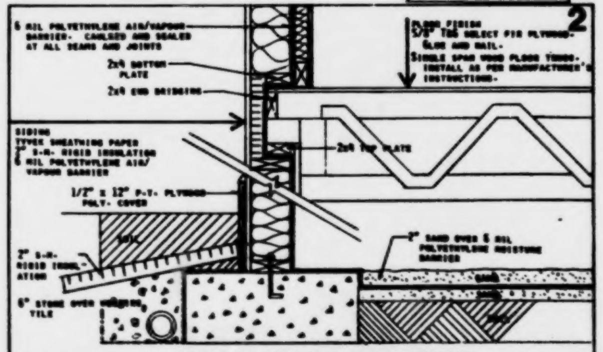

EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
2x4 BOTTOM PLATE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
SIDING
TYVEK SHEATHING PAPER
2" S-R- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER

WALL/FLOOR JOIST HEADER –CUTAWAY DETAIL

NOT TO SCALE

NOTE: ALL FLOOR COVER CHANGED TO:

FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD OR 5/8" T+G STD. SPRUCE PLY. c/w 5/16" STD. PLY. UNDERLAY. GLUE + NAIL
2x8 JOISTS @ 16" O.C.


2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
FLOOR FINISH 5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS. INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
SIDING
TYVEK SHEATHING PAPER
2" S-R- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P.T. PLYWOOD POLY. COVER
2" S-R- RIGID INSUL- ATION
6" STONE OVER WEEPING TILE
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SOIL

SCALE : 1½" = 1'-0"

SINGLE SPAN FLOOR TRUSS

[illegible]

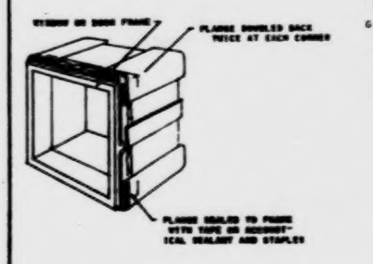
BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNER FOR CLARIFICATION. THE DESIGNER WILL NOT ASSUME RESPONSIBILITY FOR MISINTERPRETATION OF THE DRAWINGS.

CONSTRUCTION & ENGINEERING DETAILS

UTIES

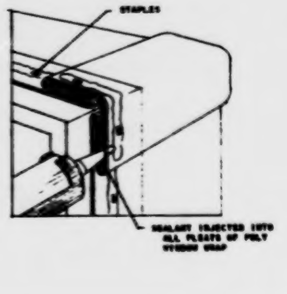
APPIN ASSOC. INC.
18-77 [illegible]
WPG. MAN.

4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

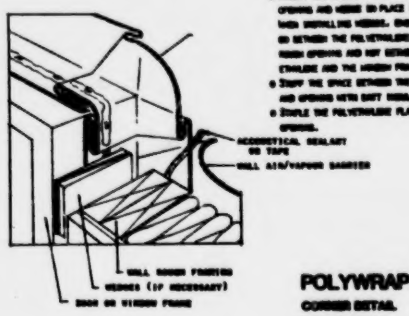
- CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 24 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO ONE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

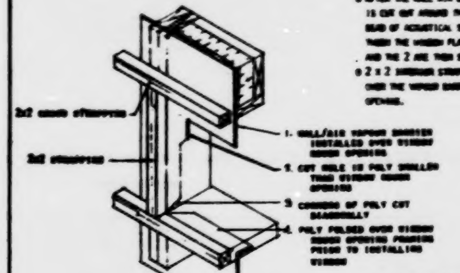
- LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2


ACOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

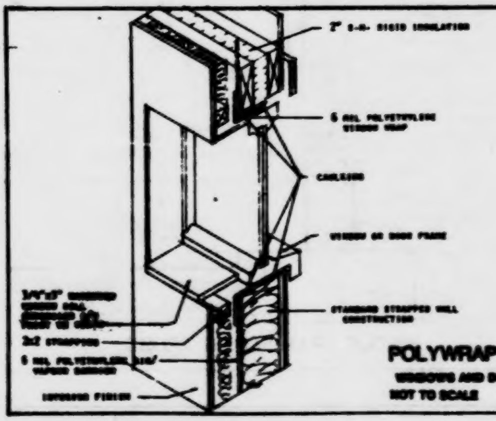
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3

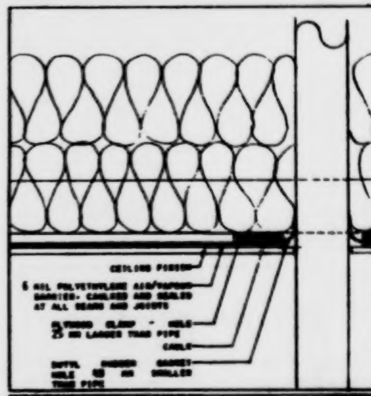

2x2 [illegible] STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 x 2 HORIZONTAL STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

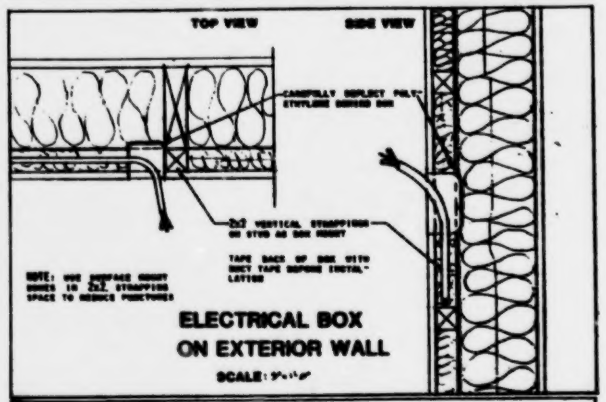
POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4


2" [illegible] RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

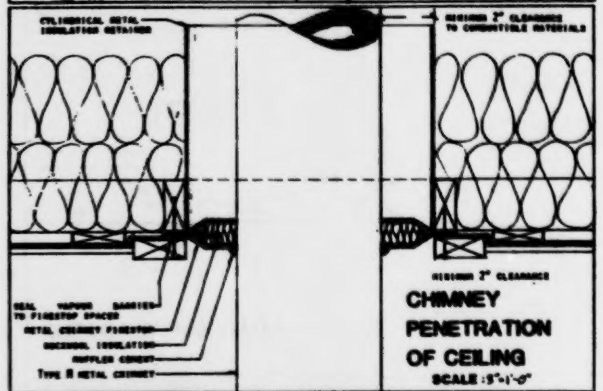
POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE
5


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CABLE
[illegible] RUBBER GASKET HOLE [illegible] SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE: 3"=1'-0"

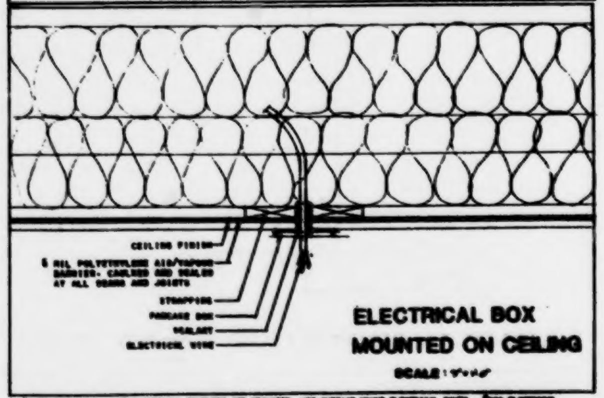

TOP VIEW
SIDE VIEW
CAREFULLY REFLECT POLYETHYLENE AROUND BOX
2x2 VERTICAL STRAPPING OR STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION
NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE: 3"=1'-0"


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY
MINIMUM 2" CLEARANCE

CHIMNEY PENETRATION OF CEILING
SCALE: 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE: 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

[illegible]

[illegible]

CONSTRUCTION & ENGINEERING DETAILS

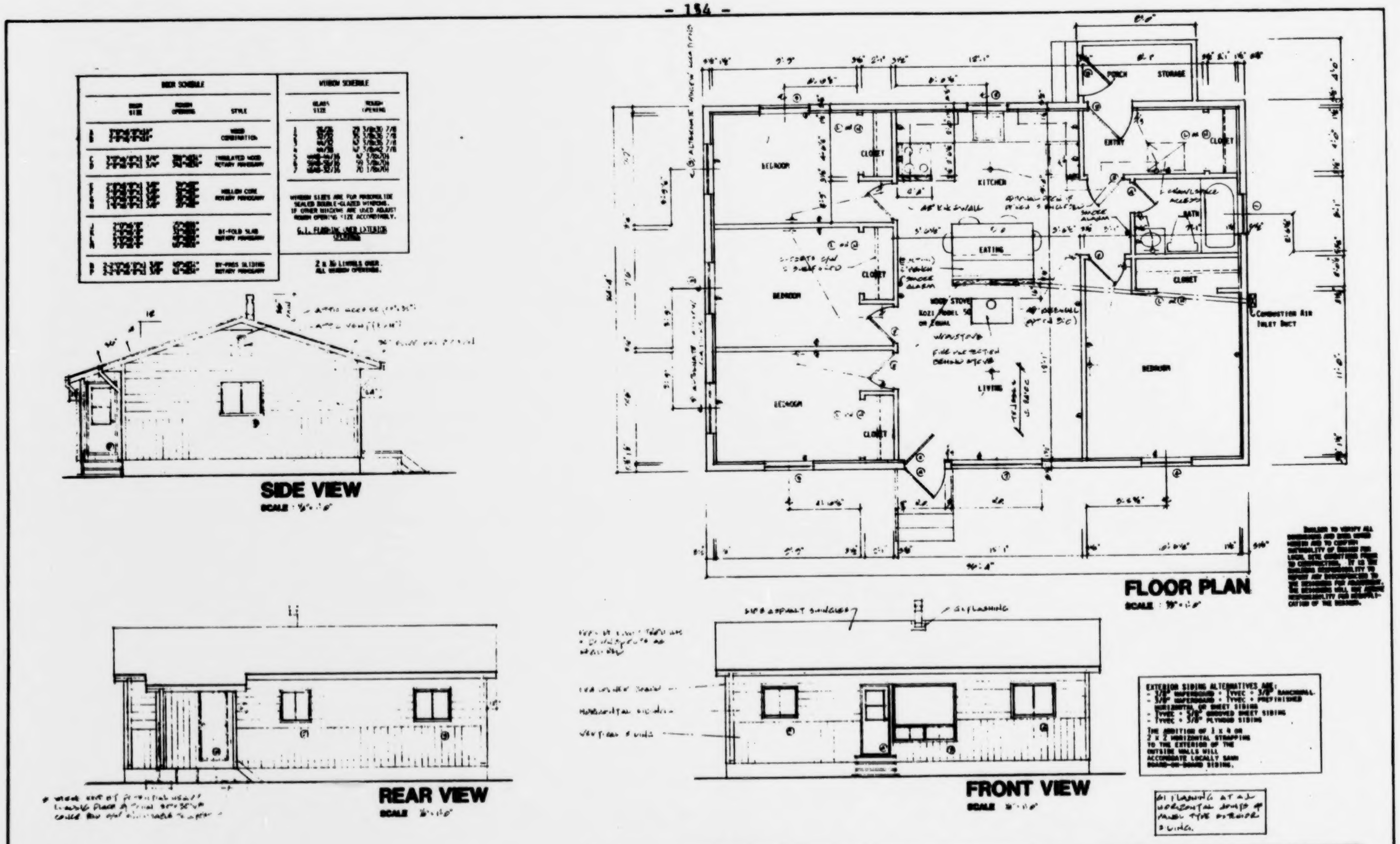
APPIN ASSOC. INC.
[illegible]

3.2.2 Plan "B" (4 bedroom version) Design Features

- Plan "B" is similar to Plan "A" in its layout, except that three bedrooms are included along the 24' width of the house instead of two as in Plan "A". To accommodate closet space, these bedrooms have been extended one foot along their length (as is also the master bedroom on the opposite side of the house). This means that the homeowner sacrifices 2' off the living room width in order to gain an extra bedroom.

- The bathroom has been made smaller than the one in Plan "A", thus allowing the inclusion of a large vestibule/storage entry within the plan itself, as well as allowing the exit to be even more accessible from the bathroom.

- The wood stove centrally located as before. The same features outlined in Plan "A" apply to Plan "B".


DOOR SCHEDULE
DOOR SIZE
ROUGH OPENING
STYLE
WOOD CONSTRUCTION
INSULATED WOOD ROTARY MAHOGANY
HOLLOW CORE ROTARY MAHOGANY
BI-FOLD SLAB ROTARY MAHOGANY
BY-PASS SLIDING ROTARY MAHOGANY
WINDOW SCHEDULE
GLASS SIZE
ROUGH OPENING
WINDOW SIZES ARE FOR PREMOULDED SEALED DOUBLE-GLAZED WINDOWS. IF OTHER WINDOWS ARE USED ADJUST ROUGH OPENING SIZE ACCORDINGLY.
G.I. FLASHING OVER EXTERIOR OPENINGS
2 x 10 LINTELS OVER ALL WINDOW OPENINGS.
SIDE VIEW
SCALE
PORCH
STORAGE
ENTRY
CLOSET
BEDROOM
KITCHEN
EATING
BATH
WOOD STOVE
LIVING
COMBUSTION AIR INLET DUCT
FLOOR PLAN
SCALE
REAR VIEW
SCALE
FRONT VIEW
SCALE
36'-0"
G.I. FLASHING AT ALL HORIZONTAL JOINTS OF PANEL TYPE EXTERIOR SIDING.

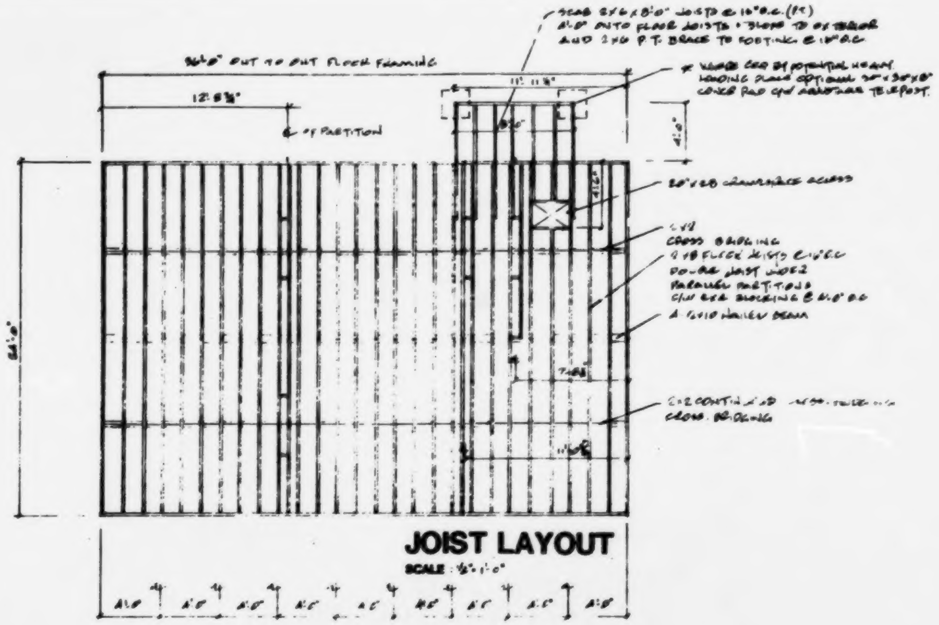
EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" WAFERBOARD + TYVEC + 3/8" [illegible]
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OF SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

24 x 36 BUNGALOW
4 BEDROOM

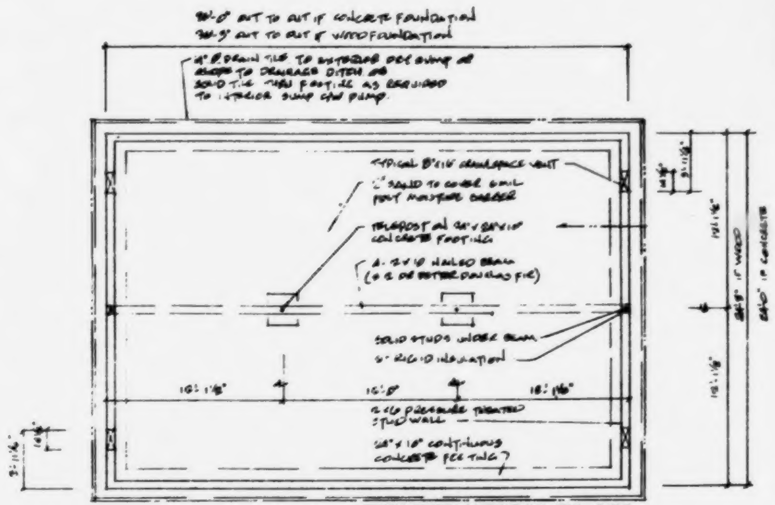
APPIN ASSOC. INC.
WPG. MAN.

F1


12'-5 3/4"
¢ of partition
2x8 cross bridging
2x8 floor joists @ 16" o.c.
double joist under parallel partitions
3-2x10 nailed beam

JOIST LAYOUT

SCALE : 1/4"=1'-0"


typical 8"x16" crawlspace vent
telepost on 24"x24"x10" concrete footing
3-2x10 nailed beam
2" rigid insulation
16'-1 1/8"
16'-0"
24"x10" continuous concrete footing

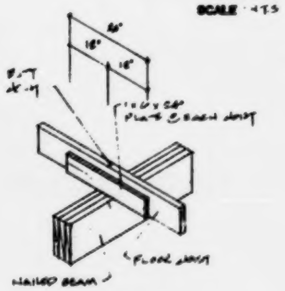
FOUNDATION PLAN

SCALE : 1/8"=1'-0"

NAILED BEAM LAYOUT

SCALE : NTS

LENGTH OF BEAM:
36'-0" if wood foundation
35'-8" if concrete foundation

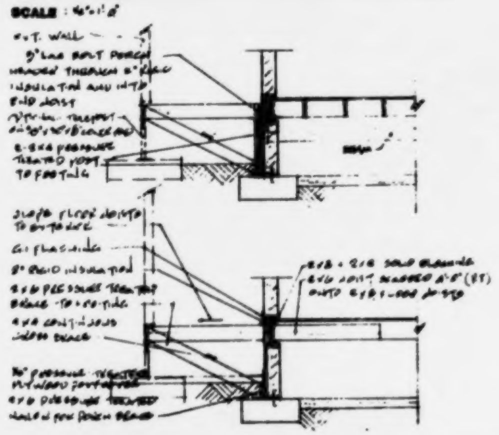

nailed beam
floor joist

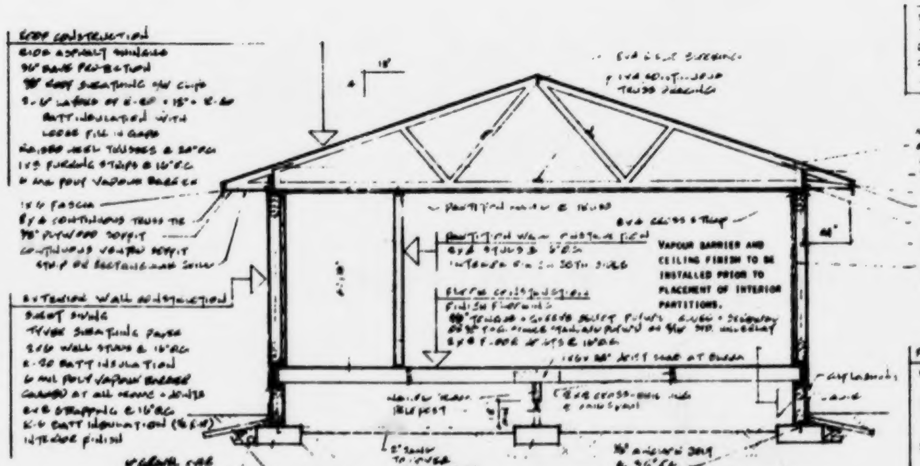
SCAB DETAIL AT FLOOR JOIST AND BEAM

NOT TO SCALE

CANTILEVERED PORCH DETAIL

SCALE : 1/2"=1'-0"




ROOF CONSTRUCTION
210# asphalt shingles
36" eave protection
3/8" roof sheathing w/ clips
raised heel trusses @ 24" o.c.
1x3 furring strips @ 16" o.c.
6 mil poly vapour barrier
1x6 fascia
3/8" plywood soffit
EXTERIOR WALL CONSTRUCTION
siding
tyvek sheathing paper
2x6 wall studs @ 16" o.c.
R-20 batt insulation
6 mil poly vapour barrier
2x2 strapping @ 16" o.c.
interior finish
18"
12

VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.

CROSS SECTION

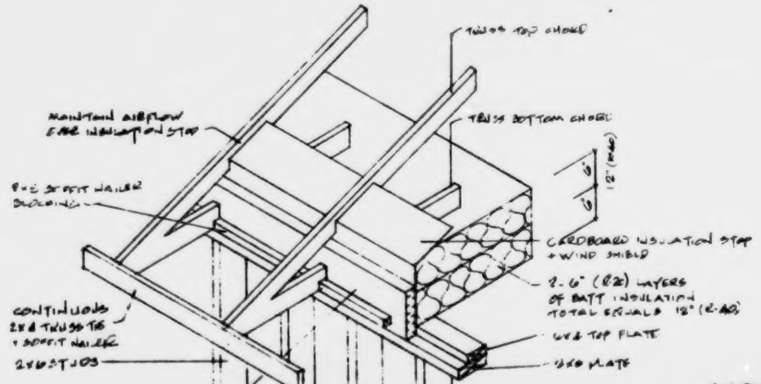
SCALE : 3/8"=1'-0"

FOUNDATION DEPTH:
AS DETERMINED BY SECT. 9.12
NATIONAL BUILDING CODE
SEE FOUNDATION DETAIL SHEET

BUNGALOW FOUNDATION DETAILS

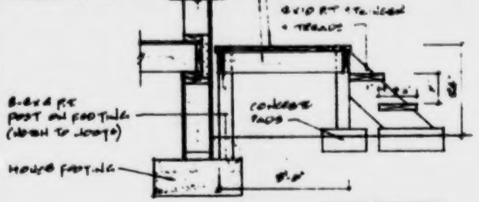
APPIN ASSOC. INC.

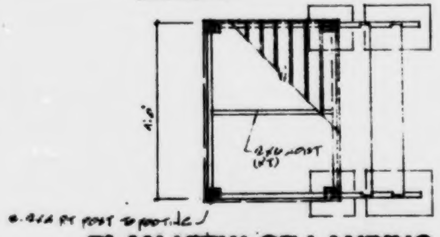
F2


TRUSS TOP CHORD
MAINTAIN AIRFLOW
EAVE INSULATION STOP
TRUSS BOTTOM CHORD
12" (MAX)
6"
6"
2x2 SOFFIT NAILER
BLOCKING
CARDBOARD INSULATION STOP
+ WIND SHIELD
2 - 6" (R20) LAYERS
OF BATT INSULATION
TOTAL EQUALS 12" (R-40)
CONTINUOUS
2x4 TRUSS TIE
+ SOFFIT NAILER
2x4 TOP PLATE
2x6 STUDS
2x6 PLATE
2" RIGID INSULATION

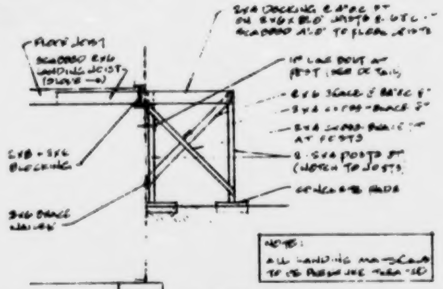
SOFFIT VENTING DETAIL
NOT TO SCALE

LANDING DETAIL
SCALE : ⅜"=1'-0"

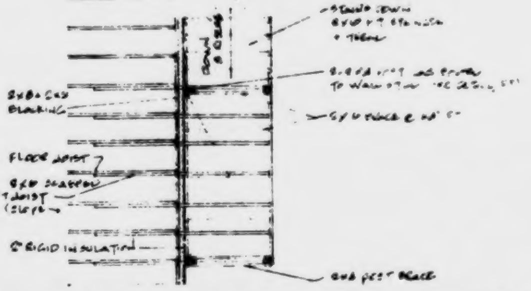

2x6 JOISTS @ 24" O.C. PT
2x4 PT DECKING
BASE
2x10 PT STRINGER
+ TREADS
2-2x4 PT
POST ON FOOTING
(NOTCH TO JOISTS)
CONCRETE
PADS
HOUSE FOOTING
8'-0"


2x6 JOIST
(PT)
4'-0"
2-2x4 PT POST TO FOOTING

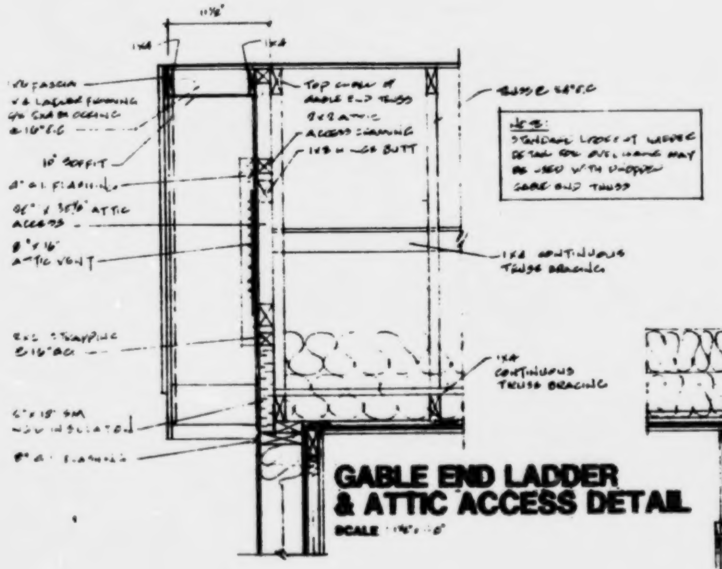
PLAN VIEW OF LANDING
SCALE : ⅜"=1'-0"


2x4 DECKING @ 24" O.C. PT
ON 2x6 x 8'-0" JOISTS
FLOOR JOIST
SCABBED 2x6
LANDING JOIST
(SLOPE →)
½" LAG BOLT AT
POST (SEE DETAIL)
2x6 BRACE @ 24" O.C.
2x4 CROSS-BRACE
2x4 CROSS-BRACE AT POSTS
2-2x4 POSTS PT
(NOTCH TO JOISTS)
2x6 + 2x6
BLOCKING
CONCRETE PADS
2x6 BRACE
NAILER
NOTE:
ALL LANDING MATERIAL
TO BE PRESSURE TREATED

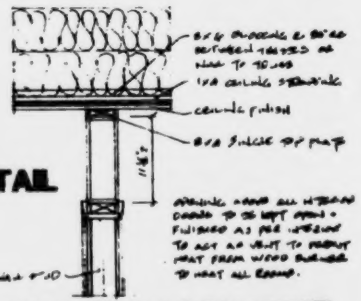
BI-LEVEL LANDING DETAIL
SCALE : ⅜"=1'-0"


STAIRS DOWN
2x10 PT STRINGER
+ TREAD
2x6 + 2x6
BLOCKING
2-2x4 POST LAG BOLTED
TO WALL STUD (SEE DETAIL)
2x4 BRACE @ 24" O.C.
FLOOR JOIST
2x6 SCABBED
PT JOIST
(SLOPE →)
2" RIGID INSULATION
2x4 POST BRACE

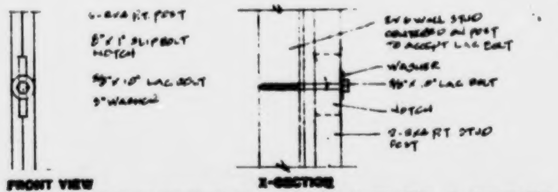
PLAN VIEW OF BI-LEVEL LANDING
SCALE : ⅜"=1'-0"


11⅛"
1x4
1x4
1x6 FASCIA
2x4 LADDER FRAMING
ON EACH END OF GABLE
@ 16" O.C.
TOP CHORD OF
GABLE END TRUSS
2x2 ATTIC
ACCESS FRAMING
1x3 HINGE BUTT
TRUSS @ 24" O.C.
10" SOFFIT
2" G.I. FLASHING
22" x 35⅝" ATTIC
ACCESS
8" x 16"
ATTIC VENT
1x4 CONTINUOUS
TRUSS BRACING
2x2 STRAPPING
@ 16" O.C.
1x4
CONTINUOUS
TRUSS BRACING
6" x 15" SM
... INSULATED
8" G.I. FLASHING
NOTE:
STANDARD LADDER AT LADDER
DETAIL FOR OVERHANG MAY
BE USED WITH DROPPED
GABLE END TRUSS

GABLE END LADDER & ATTIC ACCESS DETAIL
SCALE : 1½"=1'-0"


2x4 BLOCKING @ 24" O.C.
BETWEEN TRUSSES AS
NAIL TO TRUSS
1x4 CEILING STRAPPING
CEILING FINISH
2x4 SINGLE TOP PLATE
11⅝"
OPENING ABOVE ALL INTERIOR
DOORS TO BE LEFT OPEN +
FINISHED AS PER INTERIOR
TO ACT AS VENT TO PERMIT
HEAT FROM WOOD BURNER
TO HEAT ALL ROOMS.
WALL STUD

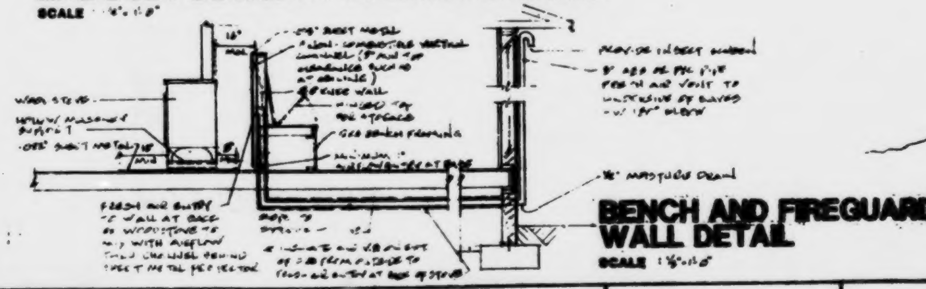
INTERIOR ROOM VENT
SCALE : 1½"=1'-0"


2-2x4 PT POST
2" x 1" SLIP BOLT
NOTCH
⅜" x 5" LAG BOLT
2" WASHER
2x6 WALL STUD
CENTERED ON POST
TO ACCEPT LAG BOLT
WASHER
⅜" x 5" LAG BOLT
NOTCH
2-2x4 PT STUD
POST

FRONT VIEW

X-SECTION

LAG BOLT DETAIL AT BI-LEVEL LANDING
SCALE : 1½"=1'-0"

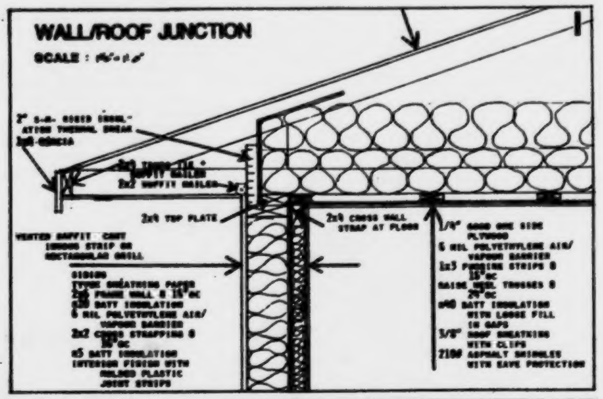

18"
MIN.
.018" SHEET METAL
+ NON-COMBUSTIBLE VERTICAL
CHANNEL (3" MIN TO
CLEARANCE SUCH AS
AT CEILING)
2x6 KNEE WALL
HINGED TOP
FOR STORAGE
2x4 BENCH FRAMING
MINIMUM 1"
CLEARANCE AT BASE
WOOD STOVE
HEARTH W/ MASONRY
SUPPORT
.018" SHEET METAL
FRESH AIR ENTRY
TO WALL AT BACK
OF WOODSTOVE TO
MIX WITH AIRFLOW
THRU CHANNEL BEHIND
SHEET METAL PROTECTOR
INSULATE AND VAPOR SEAL
OF DUCT FROM OUTSIDE TO
FRESH AIR ENTRY AT BACK OF STOVE
PROVIDE INSECT SCREEN
3" ABS OR PVC PIPE
FRESH AIR VENT TO
UNDERSIDE OF EAVES
W/ 180° ELBOW
⅜" MOISTURE DRAIN

BENCH AND FIREGUARD WALL DETAIL
SCALE : 1½"=1'-0"

CONSTRUCTION DETAILS

APPIN ASSOC. INC.

3


WALL/ROOF JUNCTION

SCALE : 3/4"=1'-0"

1
2" S-B- RIGID INSUL- ATION THERMAL BREAK
2x6 FASCIA
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 24" oc
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" oc
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" oc
RAISED HEEL TRUSSES @ 24" oc
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION

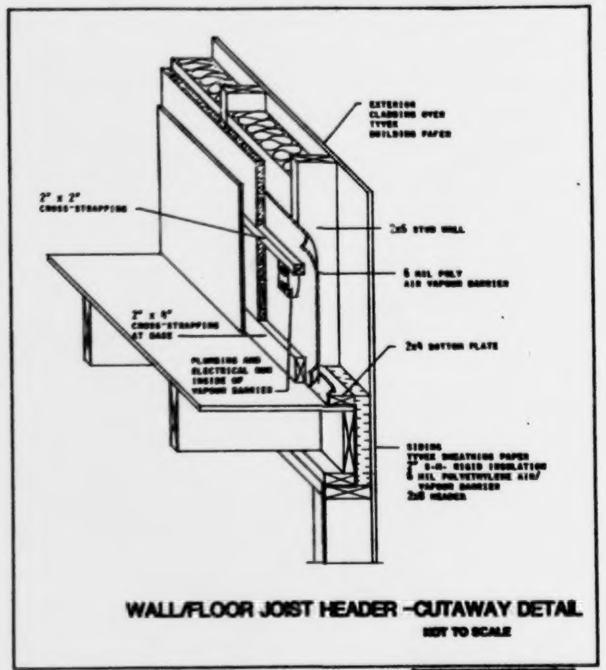
1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATHING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 X 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR THE JUNCTION BETWEEN THE FIRST FLOOR AND A PRESERVED WOOD FOUNDATION. AFTER THE FOUNDATION WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL. THE REMAINDER HANGS DOWN ON THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL IS PLACED ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

3 FRAME WALL OVERHANGS JOIST HEADER AND CONCRETE CRAWL SPACE WALL BY 2". 6 MIL POLY VAPOUR BARRIER RUNS UNDER BOTTOM PLATE OF FRAME WALL AND ON THE CRAWL SPACE WALL, TO THE FOOTING. 2" OF RIGID INSULATION IS PLACED OVER THE VAPOUR BARRIER. DO NOT INSULATE INSIDE OF JOIST HEADER. AT FOOTING, RIGID INSULATION IS EXTENDED HORIZONTALLY 2 FEET TO PROVIDE A THERMAL BREAK. GROUNDSHEET IN CRAWL SPACE IS REQUIRED FOR MOISTURE CONTROL. IT IS HELD IN PLACE AND PROTECTED BY A LAYER OF SAND OR FINE SOIL.

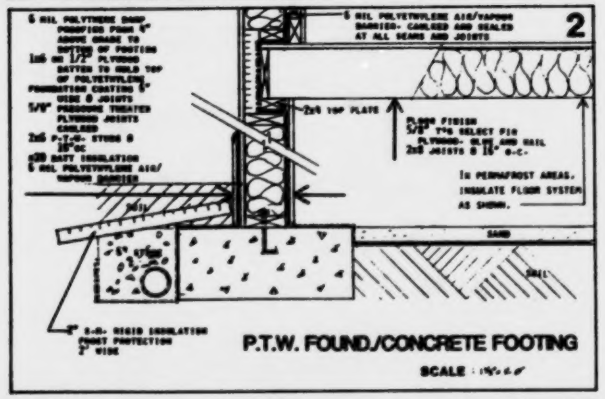
UNHEATED CRAWL SPACE IS ONLY RECOMMENDED WHERE HOUSE IS LOCATED ON PERMAFROST. THE PLYWOOD FLOOR SHEATHING SERVES AS THE FLOOR VAPOUR BARRIER. CAULK THE WALL VAPOUR BARRIER TO THE FLOOR SHEATHING AND CAULK THE SEAMS BETWEEN THE SHEETS OF PLYWOOD. A 6 MIL POLY GROUNDSHEET IS LOCATED UNDER THE HOUSE AND PROTECTED WITH A LAYER OF SAND.

THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 5.12 NATIONAL BUILDING CODE).


WALL/FLOOR JOIST HEADER -CUTAWAY DETAIL

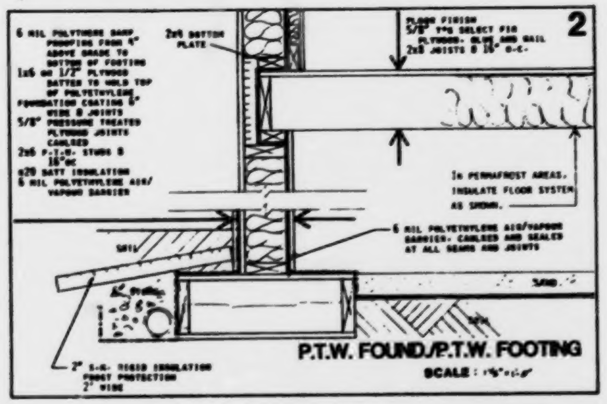
NOT TO SCALE

EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
2x4 BOTTOM PLATE
SIDING
TYVEK SHEATHING PAPER
2" S-B- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER


P.T.W. FOUND./CONCRETE FOOTING

SCALE : 1½"=1'-0"

2
6 MIL POLYTHENE DAMP PROOFING FROM 6" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 or 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"oc
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL 2x8 JOISTS @ 16" o-c-
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
SAND
SOIL
2" S-B- RIGID INSULATION FROST PROTECTION 2' WIDE

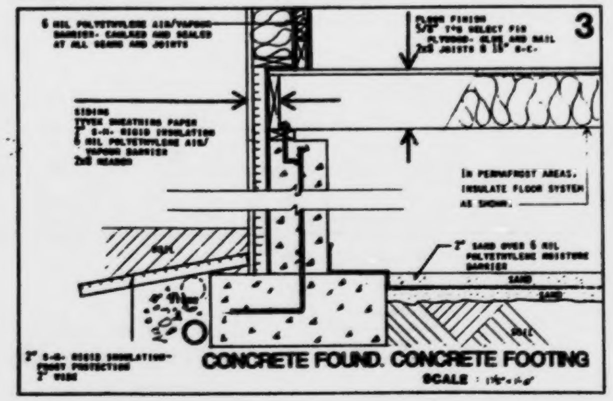

P.T.W. FOUND./P.T.W. FOOTING

SCALE : 1½"=1'-0"

2
6 MIL POLYTHENE DAMP PROOFING FROM 6" ABOVE GRADE TO BOTTOM OF FOOTING
2x4 BOTTOM PLATE
1x6 or 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"oc
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL 2x8 JOISTS @ 16" o-c-
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SOIL
SAND
2" S-B- RIGID INSULATION FROST PROTECTION 2' WIDE

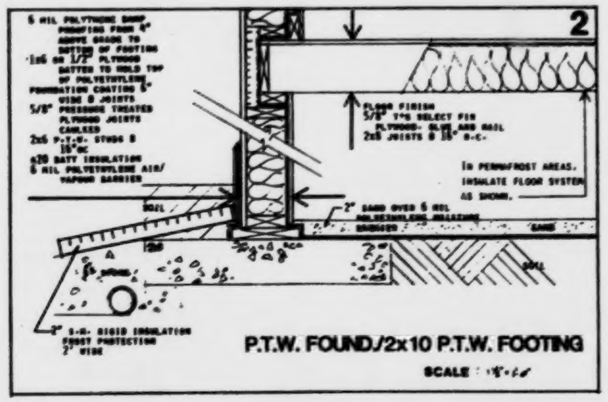
NOTE: ALL FLOOR COVER CHANGED TO:

FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD OR 3/4" T+G STD. SPRUCE PLY. C/W 5/16" STD. PLY. UNDERLAY. GLUE & NAIL. 2x8 JOISTS @ 16" O-C.


CONCRETE FOUND. CONCRETE FOOTING

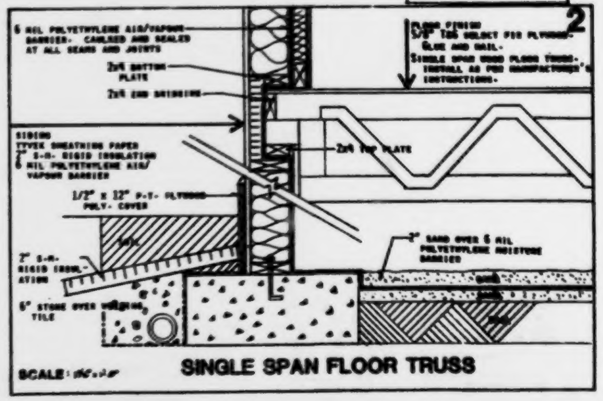
SCALE : 1½"=1'-0"

3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL 2x8 JOISTS @ 16" o-c-
SIDING
TYVEK SHEATHING PAPER
2" S-B- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SOIL
SAND
2" S-B- RIGID INSULATION- FROST PROTECTION 2' WIDE


P.T.W. FOUND./2x10 P.T.W. FOOTING

SCALE : 1½"=1'-0"

2
6 MIL POLYTHENE DAMP PROOFING FROM 6" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 or 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"oc
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL 2x8 JOISTS @ 16" o-c-
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SOIL
SAND
2" S-B- RIGID INSULATION FROST PROTECTION 2' WIDE


SINGLE SPAN FLOOR TRUSS

SCALE : 3/4"=1'-0"

2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 2ND BRIDGING
FLOOR FINISH 5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS- INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
SIDING
TYVEK SHEATHING PAPER
2" S-B- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P-T- PLYWOOD POLY- COVER
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
2" S-B- RIGID INSUL- ATION
6" STONE OVER WEEPING TILE

[illegible]

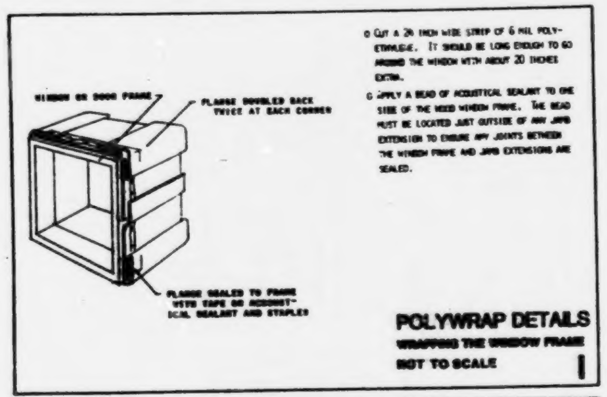
BUILDER TO VERIFY ALL DIMENSIONS AND SOILS NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDER'S RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGN.

CONSTRUCTION & ENGINEERING DETAILS

UNIES Ltd.

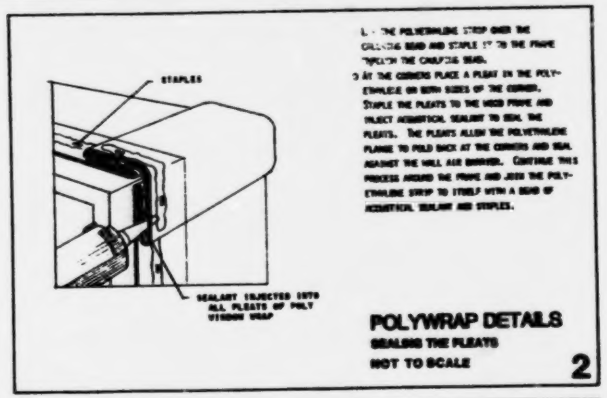
APPIN ASSOC. INC.
18-77 [illegible]
WPG. MAN.

4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

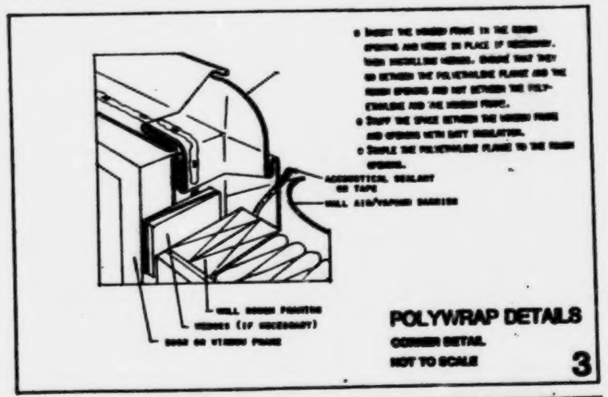
- CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO ONE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

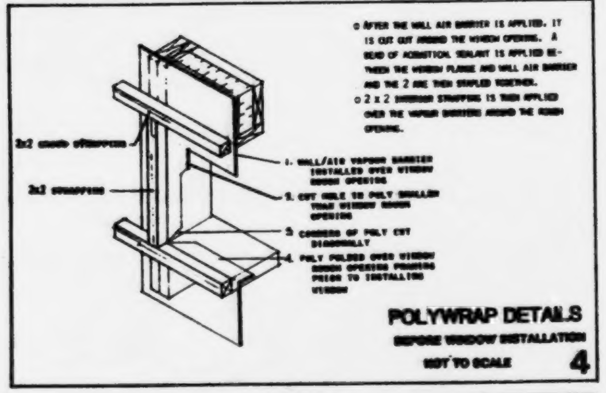
- [illegible] THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2


ACOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

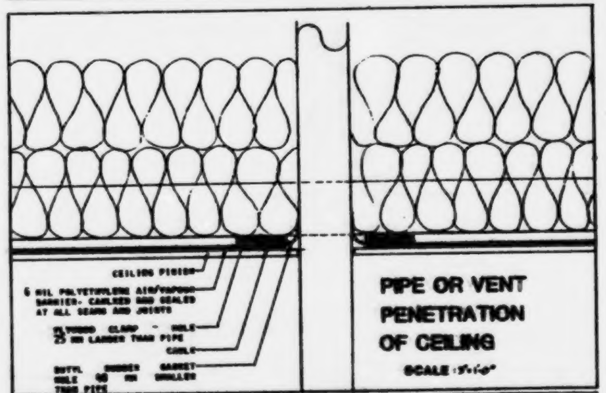
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3

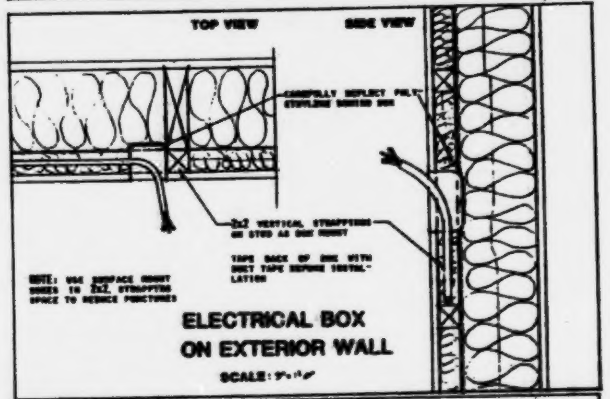

2x2 [illegible] STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 x 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

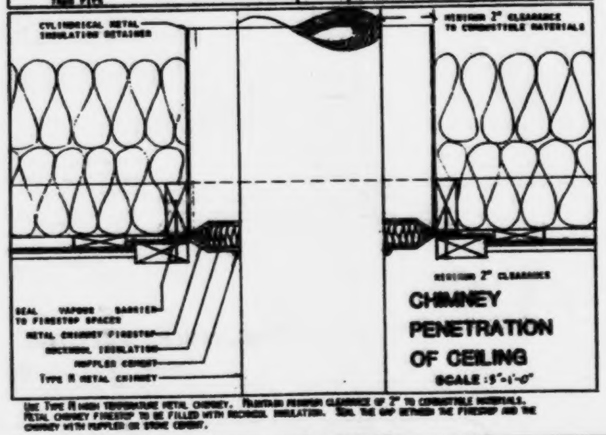
POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 10 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE: 3"=1'-0"

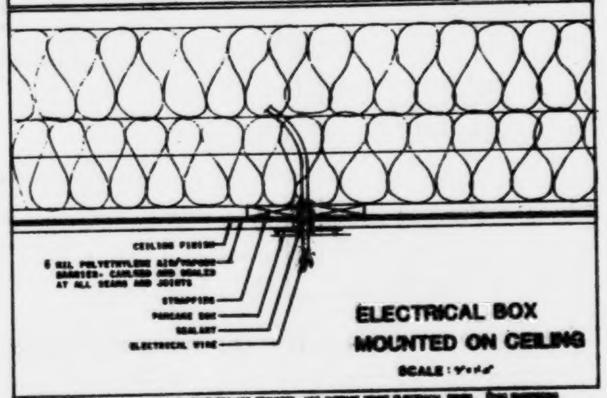

TOP VIEW
SIDE VIEW
CAREFULLY REFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPING OR STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION
NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE: 3"=1'-0"


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY
MINIMUM 2" CLEARANCE

CHIMNEY PENETRATION OF CEILING
SCALE: 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE: 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. [illegible] WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG [illegible] TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNER FOR ADJUSTMENT. THE DESIGNER WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGN.

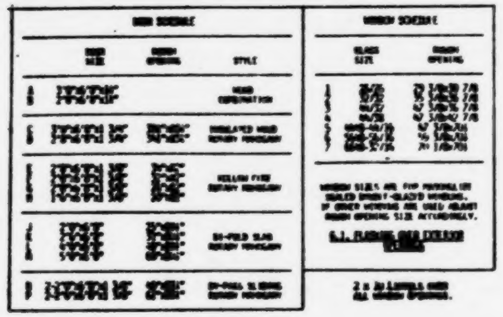
CONSTRUCTION & ENGINEERING DETAILS

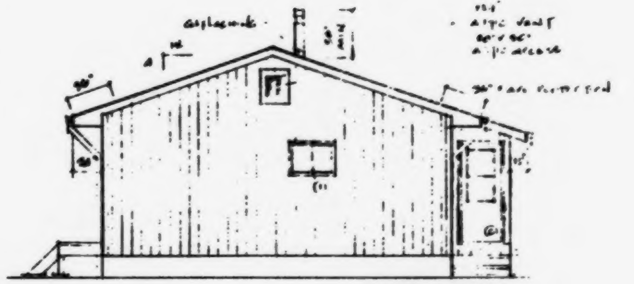
APPIN ASSOC. INC.
10-77 [illegible]
WPG. MAN.

3.2.3 Plan "C" (alternative 3 bedroom version) Design Features

- Again, this plan is similar to Plan "A" except at the rear entry where a vestibule entry has been included along with a utility/storage area which opens off of it. To do this, the bathroom was made smaller and more centralized along the width of the house.

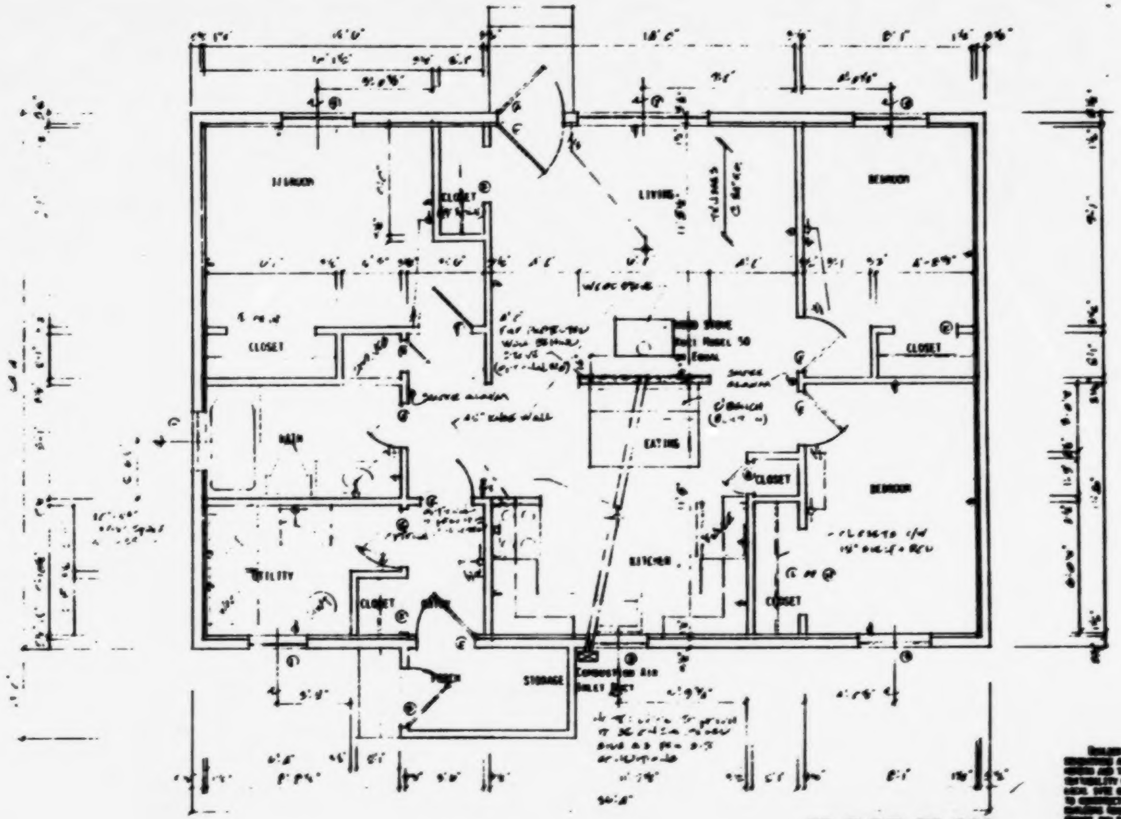
- The bedroom sizes have remained virtually the same as in Plan "A". Only the shape of the master bedroom has changed.





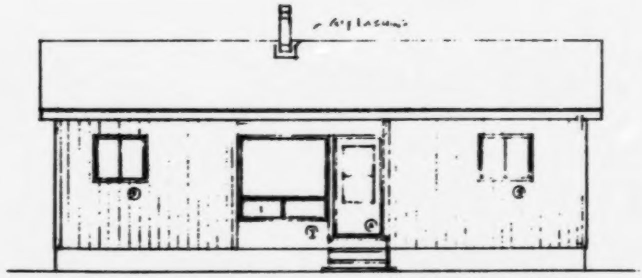
SIDE VIEW

SCALE : 1/4" = 1'0"


LIVING
BEDROOM
CLOSET
BATH
EATING
KITCHEN
UTILITY
PORCH
STORAGE

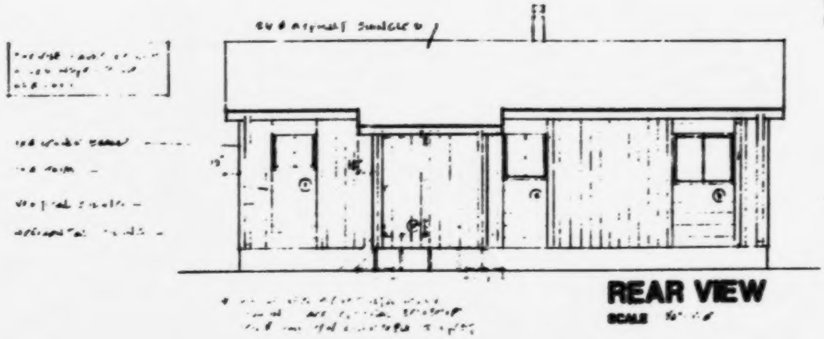
FLOOR PLAN

SCALE : 1/4" = 1'0"



FRONT VIEW

SCALE : 1/4" = 1'0"



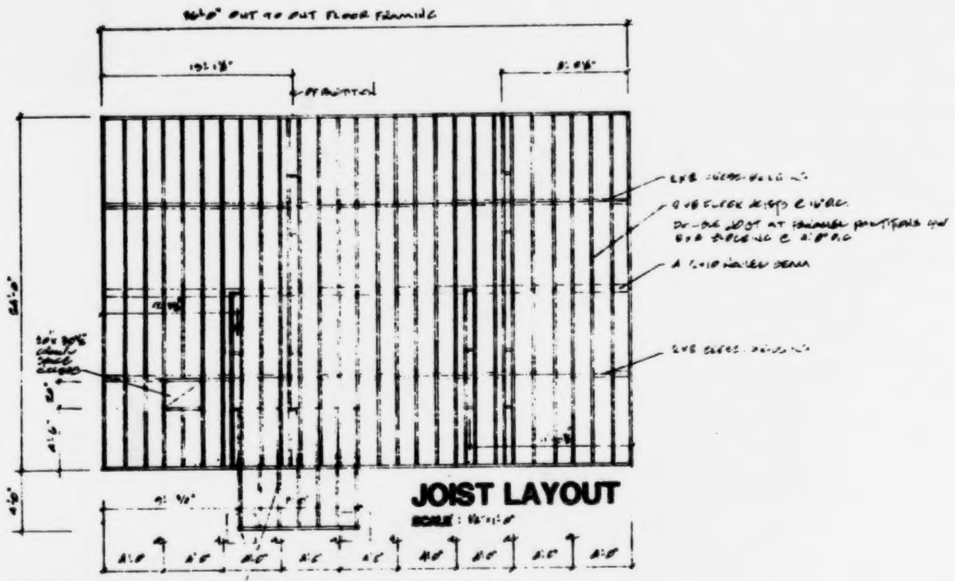
REAR VIEW

SCALE : 1/4" = 1'0"

EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" WAFERBOARD + TYVEC + 3/8" [illegible]
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

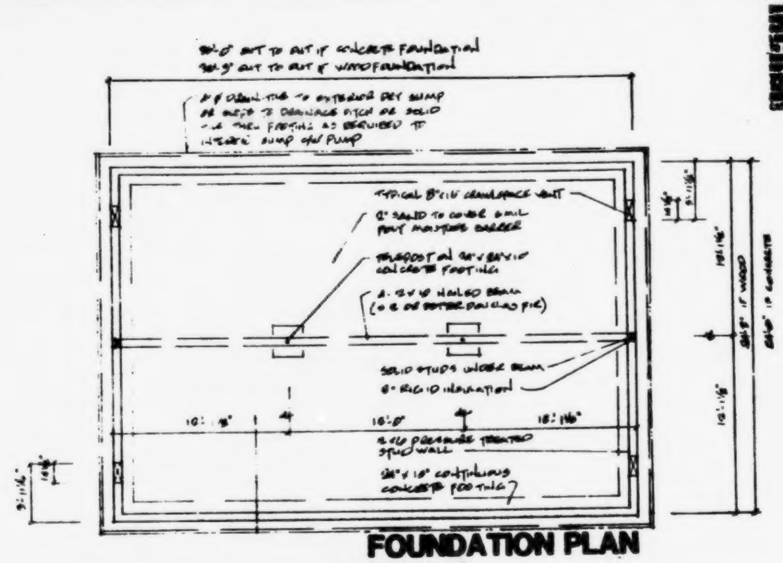
24 x 36 BUNGALOW 3 BEDROOM	APPIN ASSOC. INC.	E1



36'-0" OUT TO OUT FLOOR FRAMING
2x8 FLOOR JOISTS @ 16" O.C.
A 3-PLY NAILED BEAM

JOIST LAYOUT

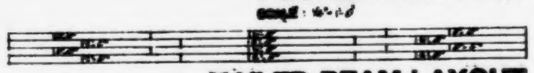
SCALE : 1/8"=1'-0"



36'-0" OUT TO OUT IF CONCRETE FOUNDATION
36'-9" OUT TO OUT IF WOOD FOUNDATION
TYPICAL 8"x16" CRAWLSPACE VENT
2" SAND TO COVER 6 MIL POLY MOISTURE BARRIER
SOLID STUDS UNDER BEAM
2" RIGID INSULATION
2x6 PRESSURE TREATED STUD WALL
24"x 10" CONTINUOUS CONCRETE FOOTING
10'-1/8"
13'-0"
13'-11/8"

FOUNDATION PLAN

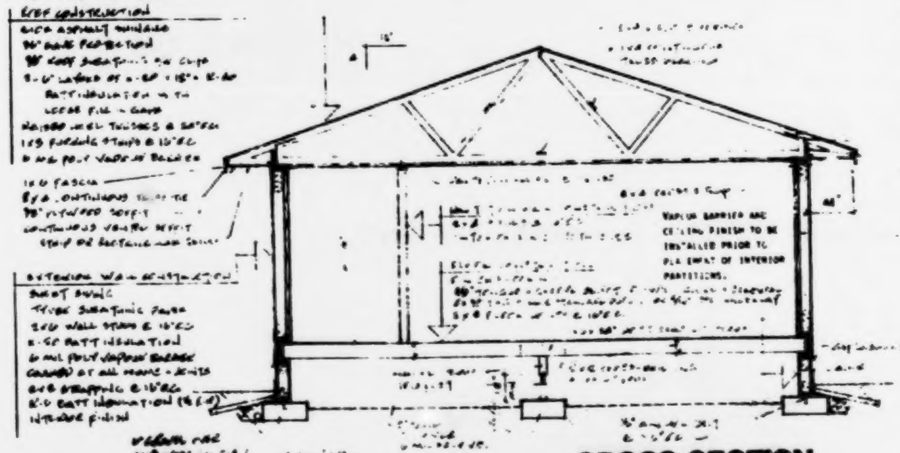
SCALE : 1/8"=1'-0"



NAILED BEAM LAYOUT

SCALE : N.T.S.

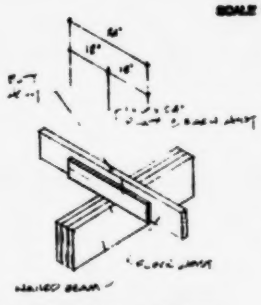
LENGTH OF BEAM:
36'-0" IF WOOD FOUNDATION
35'-5" IF CONCRETE FOUNDATION



ROOF CONSTRUCTION
EXTERIOR WALL CONSTRUCTION
1x6 FASCIA
VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.

CROSS SECTION

SCALE : 1/8"=1'-0"



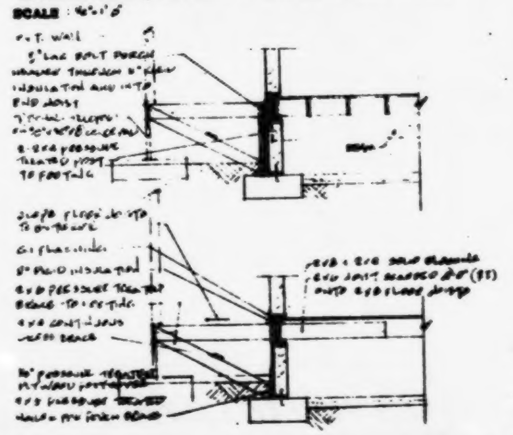
16"
18"
18"
NAILED BEAM
FLOOR JOIST

SCAB DETAIL AT FLOOR JOIST AND BEAM

NOT TO SCALE

CANTILEVERED PORCH DETAIL

SCALE : 1/2"=1'-0"

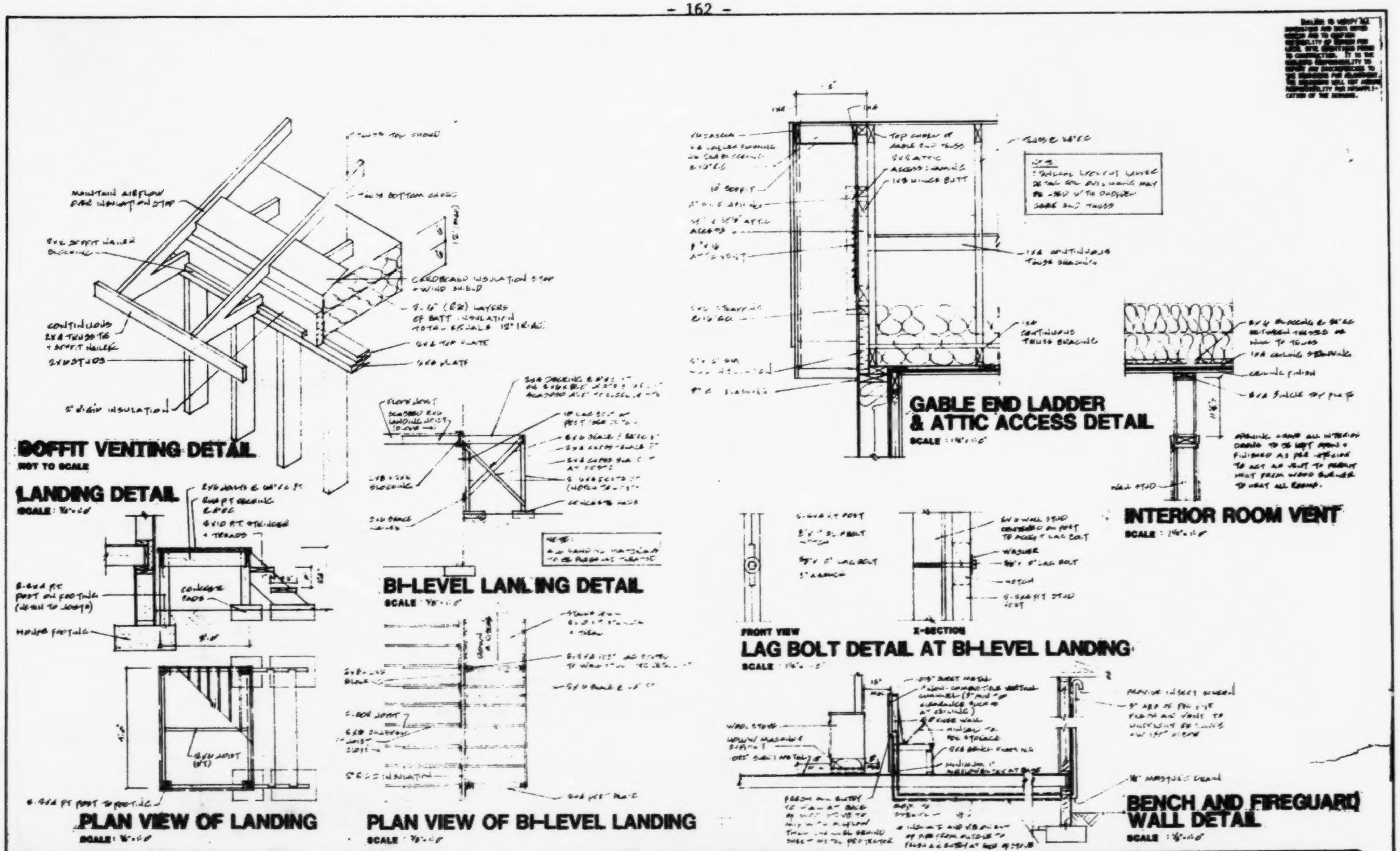


FOUNDATION DEPTH:
AS DETERMINED BY ART. 9.12 NATIONAL BUILDING CODE
SEE FOUNDATION DETAIL SHEET

BUNGALOW FOUNDATION DETAILS

APPIN ASSOC. INC.

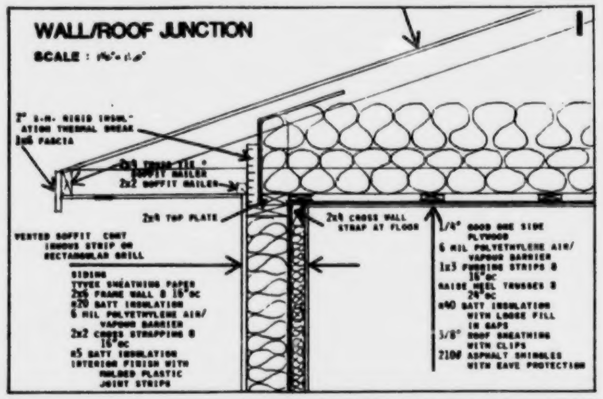
E2


MAINTAIN AIRFLOW OVER INSULATION STOP
TRUSS TOP CHORD
TRUSS BOTTOM CHORD
2x6 SOFFIT NAILER BLOCKING
CARDBOARD INSULATION STOP + WIND SHIELD
2 - 6" (R20) LAYERS OF BATT INSULATION TOTAL EQUALS 12" (R-40)
CONTINUOUS 2x4 TRUSS TIE + SOFFIT NAILER
2x6 STUDS
2x6 TOP PLATE
2x6 PLATE
2" RIGID INSULATION
SOFFIT VENTING DETAIL
NOT TO SCALE
LANDING DETAIL
SCALE : ¾"=1'-0"
2x6 JOISTS @ 24" O.C. P.T.
2x4 P.T. DECKING
6x10 P.T. STRINGER + TREADS
CONCRETE PADS
HOUSE FOOTING
FLOOR JOIST
2x8 + 2x6 BLOCKING
2x6 BRACE
CONCRETE PADS
NOTE:
BI-LEVEL LANDING DETAIL
SCALE : ¾"=1'-0"
FLOOR JOIST
2" RIGID INSULATION
PLAN VIEW OF LANDING
SCALE : ¾"=1'-0"
PLAN VIEW OF BI-LEVEL LANDING
SCALE : ¾"=1'-0"
1x4
1x4
TOP CHORD OF GABLE END TRUSS
2x6 ATTIC ACCESS FRAMING
1x8 HINGE BUTT
TRUSS @ 24" O.C.
10" SOFFIT
ATTIC ACCESS
ATTIC VENT
1x4 CONTINUOUS TRUSS BRACING
1x4 CONTINUOUS TRUSS BRACING
GABLE END LADDER & ATTIC ACCESS DETAIL
SCALE : 1½"=1'-0"
1x4 CEILING STRAPPING
CEILING FINISH
2x6 SINGLE TOP PLATE
WALL STUD
OPENING ABOVE ALL INTERIOR DOORS TO BE LEFT OPEN + FINISHED AS PER INTERIOR TO ACT AS VENT TO PERMIT HEAT FROM WOOD BURNER TO HEAT ALL ROOMS.
INTERIOR ROOM VENT
SCALE : 1½"=1'-0"
2x6 WALL STUD CENTERED ON POST TO ACCEPT LAG BOLT
WASHER
NOTCH
FRONT VIEW
X-SECTION
LAG BOLT DETAIL AT BI-LEVEL LANDING
SCALE : 1½"=1'-0"
WALL STUD
BENCH AND FIREGUARD WALL DETAIL
SCALE : ½"=1'-0"

CONSTRUCTION DETAILS

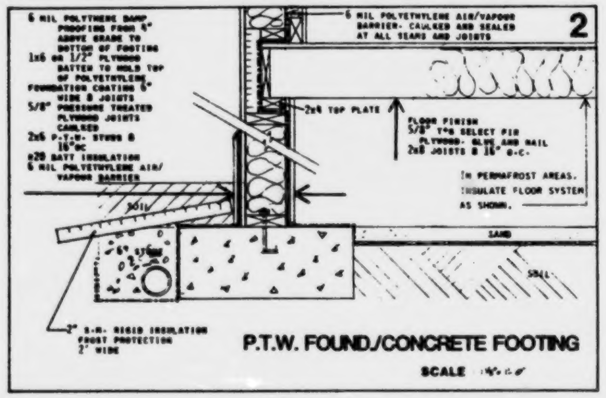
APPIN ASSOC. INC.

3


1
2" S.M. RIGID INSUL-ATION THERMAL BREAK
1x6 FASCIA
2x4 TRUSS TIE + SOFFIT NAILER
2x2 SOFFIT NAILER
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONTINUOUS STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" OC
RAISE HEEL TRUSSES @ 24" OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION

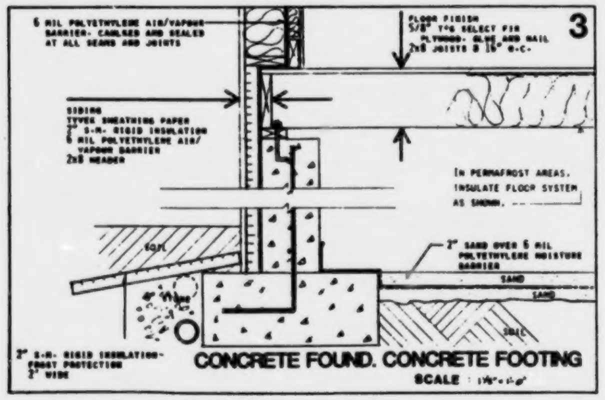
WALL/ROOF JUNCTION

SCALE : 1½" = 1'-0"


2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
6" STONE
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE

P.T.W. FOUND./CONCRETE FOOTING

SCALE : 1½" = 1'-0"


3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SAND
4" STONE
SOIL
2" S.M. RIGID INSULATION-FROST PROTECTION 2' WIDE

CONCRETE FOUND. CONCRETE FOOTING

SCALE : 1½" = 1'-0"

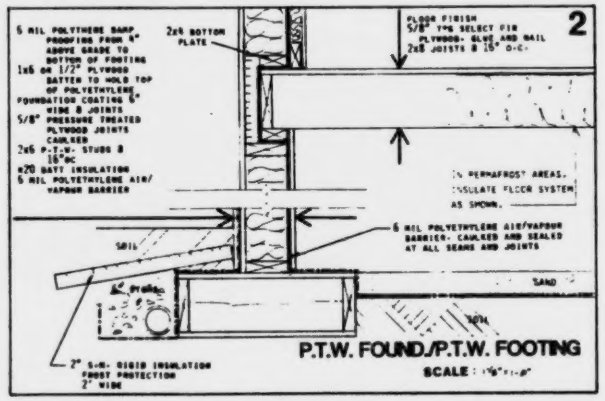
1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 X 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR THE JUNCTION BETWEEN THE FIRST FLOOR AND A PRESERVED WOOD FOUNDATION. AFTER THE FOUNDATION WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL, THE REMAINDER HANGS DOWN ON THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL IS PLACED ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

3 FRAME WALL OVERHANGS JOIST HEADER AND CONCRETE CRAWL SPACE WALL BY 2". 6 MIL POLY VAPOUR BARRIER RUNS UNDER BOTTOM PLATE OF FRAME WALL AND ON THE CRAWL SPACE WALL, TO THE FOOTING. 2" OF RIGID INSULATION IS PLACED OVER THE VAPOUR BARRIER. DO NOT INSULATE INSIDE OF JOIST HEADER. AT FOOTING, RIGID INSULATION IS EXTENDED HORIZONTALLY 2 FEET TO PROVIDE A THERMAL BREAK. GROUNDSHEET IN CRAWL SPACE IS REQUIRED FOR MOISTURE CONTROL. IT IS HELD IN PLACE AND PROTECTED BY A LAYER OF SAND OR FINE SOIL.

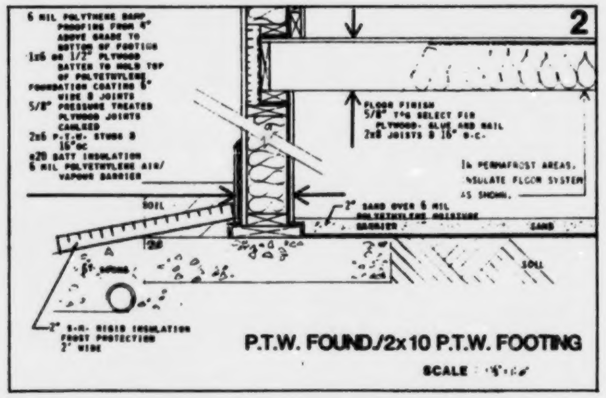
UNHEATED CRAWL SPACE IS ONLY RECOMMENDED WHERE HOUSE IS LOCATED ON PERMAFROST. THE PLYWOOD FLOOR SHEATING SERVES AS THE FLOOR VAPOUR BARRIER. CAULK THE WALL VAPOUR BARRIER TO THE FLOOR SHEATING AND CAULK THE SEAMS BETWEEN THE SHEETS OF PLYWOOD. A 6 MIL POLY GROUNDSHEET IS LOCATED UNDER THE HOUSE AND PROTECTED WITH A LAYER OF SAND.

THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).


2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 BOTTOM PLATE
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SOIL
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE

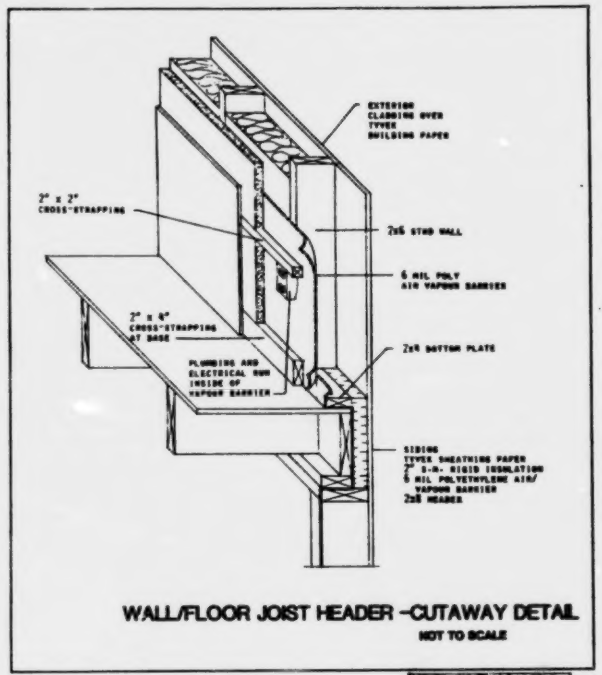
P.T.W. FOUND./P.T.W. FOOTING

SCALE : 1/2" = 1'-0"


2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE

P.T.W. FOUND./2x10 P.T.W. FOOTING

SCALE : 1/2" = 1'-0"

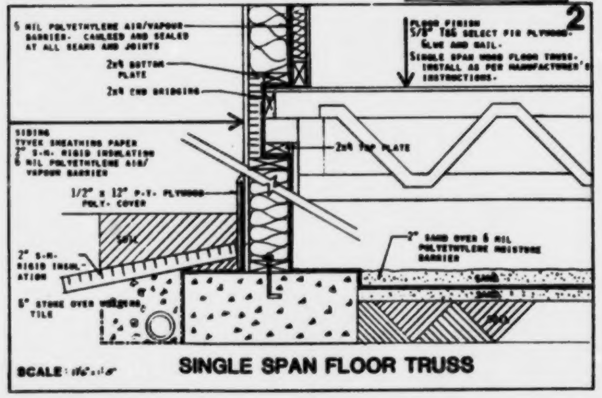

EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
2x4 BOTTOM PLATE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER

WALL/FLOOR JOIST HEADER -CUTAWAY DETAIL

NOT TO SCALE

NOTE: ALL FLOOR CONST. CHANGED TO:

FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD OR 5/8" T+G STD. SPRUCE PLY. C/W 5/16" STD. PLY. UNDERLAY. GLUE + NAIL
2x8 JOISTS @ 16" O.C.


2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS. INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P.T. PLYWOOD POLY. COVER
SOIL
2" S.M. RIGID INSUL-ATION
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
6" STONE OVER WEEPING TILE
SAND
SAND

SINGLE SPAN FLOOR TRUSS

SCALE : 1/2" = 1'-0"

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS [illegible] IN SPECIFIC [illegible] NORTHERN [illegible] [illegible] WITH LIMITED ELECTRICAL AND OTHER SERVICES. [illegible] ARE USED WHERE DIFFERENT CONDITIONS EXIST, [illegible] EXAMPLE, IF [illegible] A DIFFERENT HEATING SYSTEM USED OR ANY [illegible], THEN IT IS THE RESPONSIBILITY OF THE [illegible] AUTHORITY TO MODIFY THE DESIGNS AS NECESSARY.

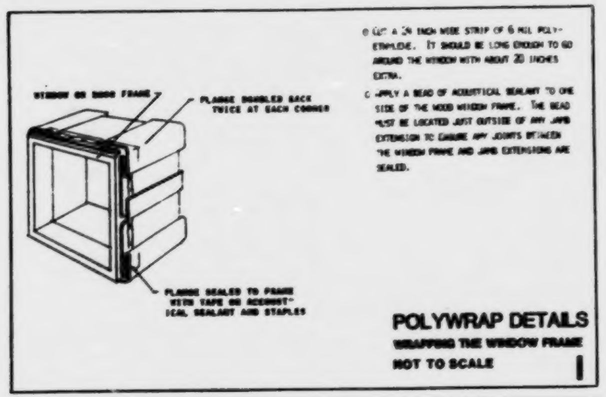
BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION &
ENGINEERING DETAILS

UNIES Ltd.

APPIN ASSOC. INC.
13-77 [illegible]
WPG. MAN.

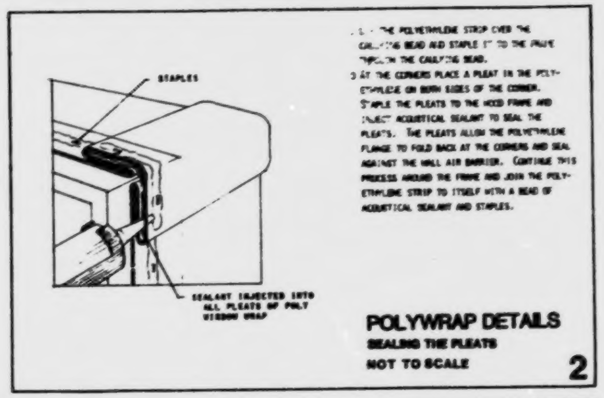
4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

○ CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.

○ APPLY A BEAD OF ACOUSTICAL SEALANT TO ONE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

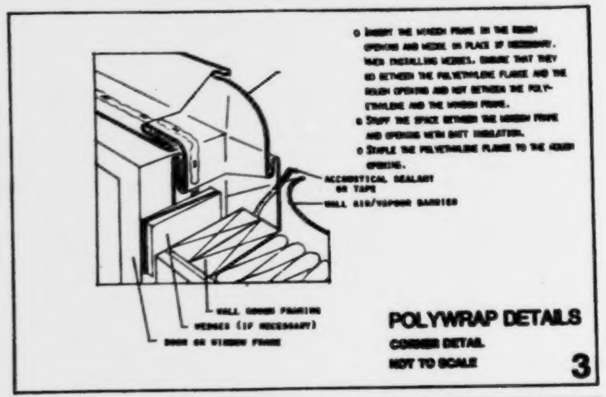
POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

○ LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.

○ AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2

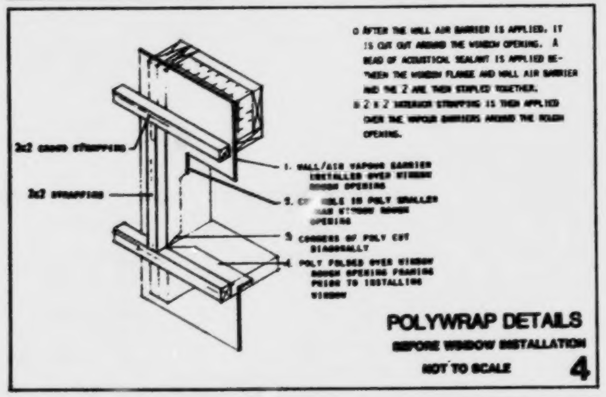

ACOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

○ INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.

○ STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.

○ STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

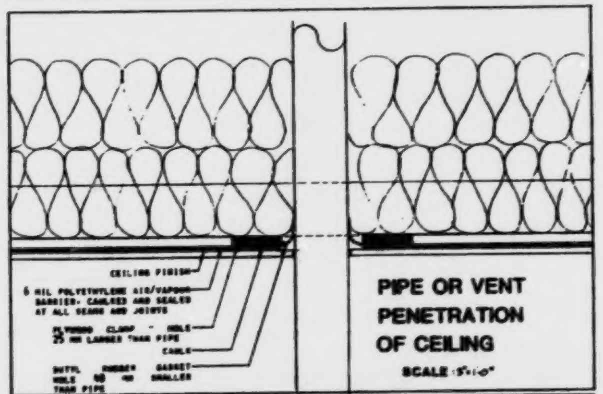
POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3


2x2 CROSS STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

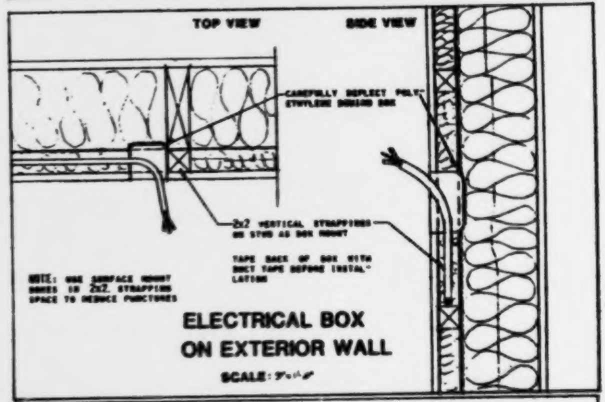
○ AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.

○ 2 X 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4

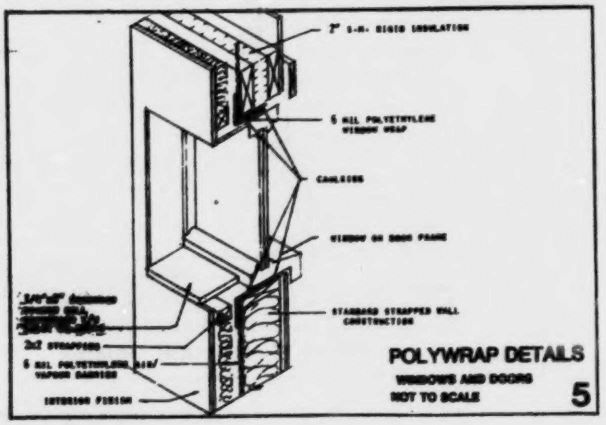

CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 10 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE: 3"=1'-0"

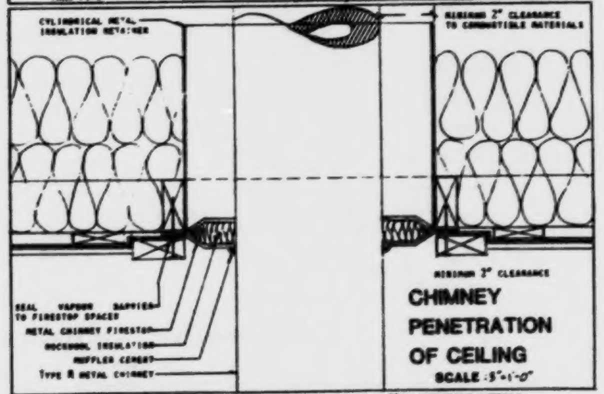

TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE AROUND BOX
2x2 VERTICAL STRAPPING ON STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION

NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE: 3"=1'-0"

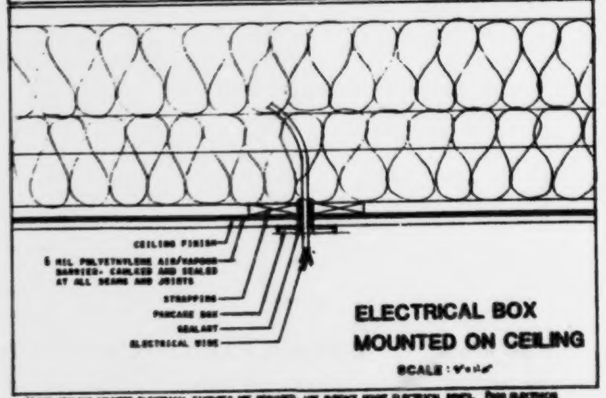

2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE
5


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
MINIMUM 2" CLEARANCE
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY

CHIMNEY PENETRATION OF CEILING
SCALE: 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE: 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS

UNIES LTD

APPIN ASSOC. INC.
15-77 [illegible]
WPG. MAN.

5

3.3 24' x 28' Bungalow Plans

There is approximately 672 sq. ft. allowed for each plan. Each is described in turn.

3.3.1 Plan "A" (2 bedroom version) Design Features

- The exit is readily accessible from the bathroom.
- The vestibule entry can be incorporated by either adding a second door (to close off the short hallway), or through the addition of an entry/storage shed to the exterior.
- The wood stove is located in such a manner as to be conveniently available for use as a cooking surface (if required).
- Due to the small size of the house, inadequate heat distribution should not be a problem.
- The secondary exit for use during summers and/or emergencies has been provided from the living room.
- No room that is strictly for storage has been provided.
- The dining area includes the use of a built-in bench seat.

3.3.2 Plan "B" (2 bedroom alternate version) Design Features

- A re-arrangement of Plan "A" which made room for a vestibule entry incorporated into the floor plan, as well as a room for use as a storage or utility area. In doing this, the homeowner makes sacrifices in the size of the living room area of the house as well as in the size of the bedrooms, all of which are now smaller.
- The wood stove has been relocated to a more centralized position within the plan.

	DOOR SIZE	ROUGH OPENING	STYLE
A B	[illegible] [illegible]		WOOD CONSTRUCTION
C D	[illegible] [illegible]	[illegible] [illegible]	INSULATED WOOD ROTARY MAHOGANY
E F G H	[illegible]	[illegible]	HOLLOW CORE ROTARY MAHOGANY
J K L M	[illegible]	[illegible]	BI-FOLD SLAB ROTARY MAHOGANY
N P	[illegible] [illegible]	[illegible] [illegible]	BY-PASS SLIDING ROTARY MAHOGANY

	GLASS SIZE	ROUGH OPENING
1	[illegible]	[illegible] 7/8
2	[illegible]	[illegible] 7/8
3	[illegible]	[illegible] 7/8
4	[illegible]	[illegible] 7/8
5	[illegible]	[illegible]
6	[illegible]	[illegible]
7	[illegible]	[illegible]

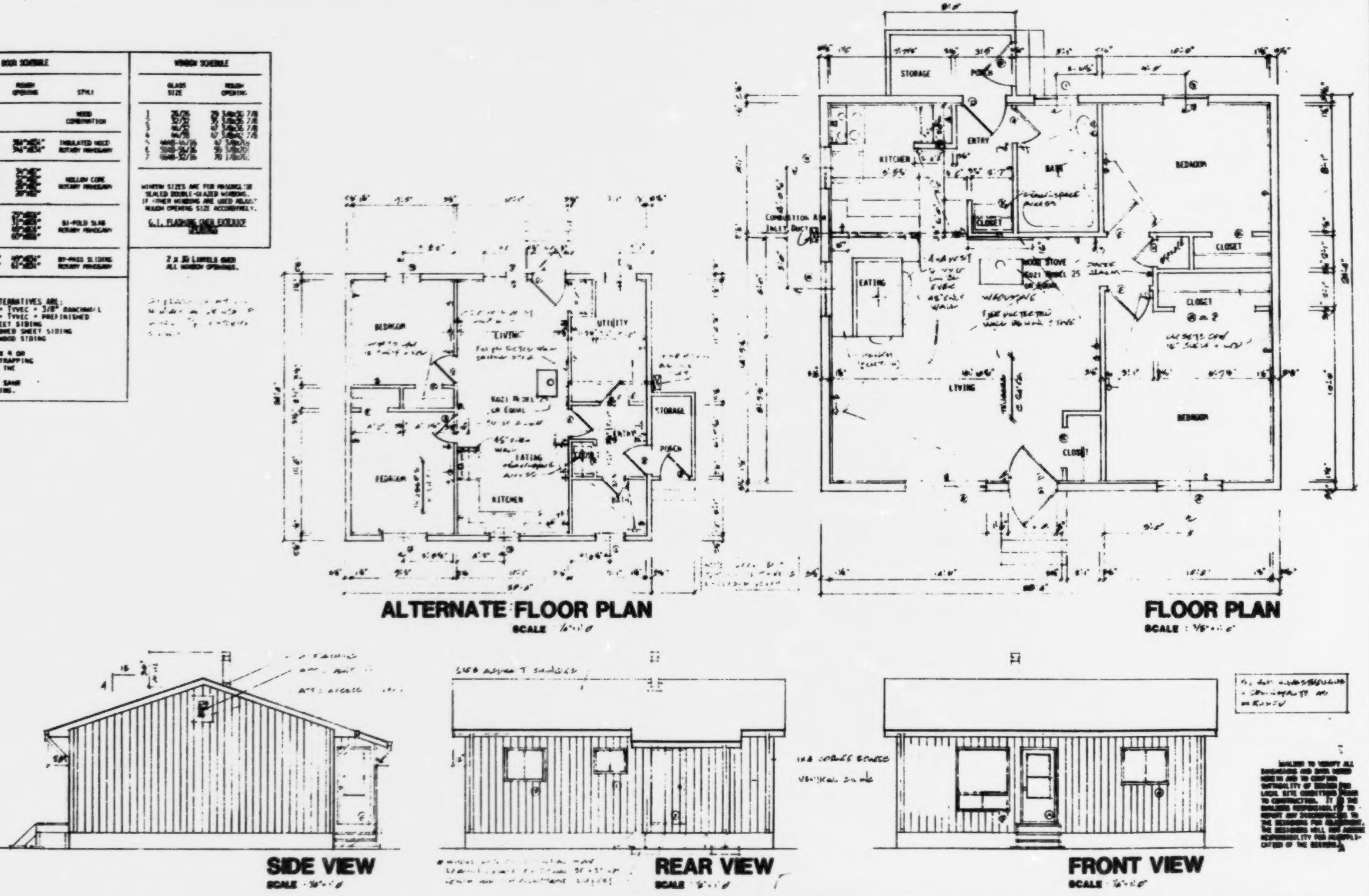
WINDOW SIZES ARE FOR MAXIMUM SEALED DOUBLE-GLAZED WINDOWS. IF OTHER WINDOWS ARE USED ADJUST ROUGH OPENING SIZE ACCORDINGLY.

G.I. FLASHING OVER EXTERIOR OPENINGS

2 x 10 LINTELS OVER ALL WINDOW OPENINGS.

EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" WAFERBOARD + TYVEC + 3/8" RANCHWALL
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

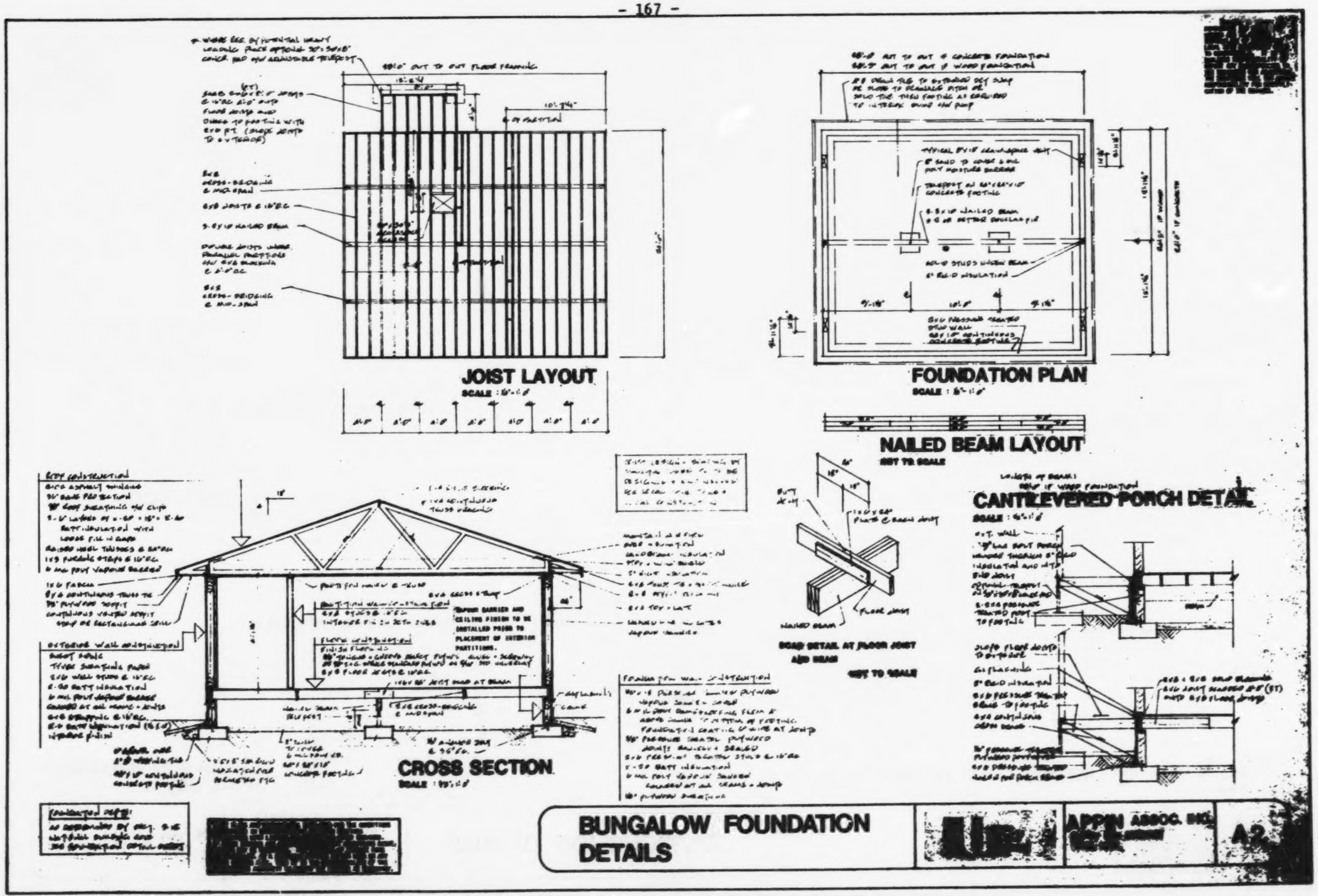
THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

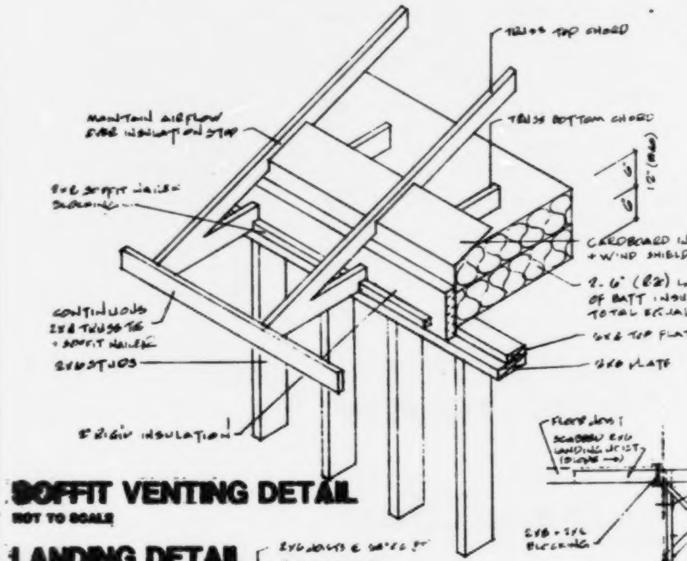

ALTERNATE FLOOR PLAN
SCALE
BEDROOM
LIVING
UTILITY
STORAGE
PORCH
EATING
KITCHEN
BEDROOM
FLOOR PLAN
SCALE
STORAGE
PORCH
ENTRY
KITCHEN
BATH
BEDROOM
CLOSET
WOOD STOVE
EATING
LIVING
CLOSET
BEDROOM
CLOSET
SIDE VIEW
SCALE
REAR VIEW
SCALE
FRONT VIEW
SCALE

24 x 28 BUNGALOW
2 BEDROOM

APPIN ASSOC. INC.

A1


JOIST LAYOUT
FOUNDATION PLAN
NAILED BEAM LAYOUT
NOT TO SCALE
CANTILEVERED PORCH DETAIL
CROSS SECTION
VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.
NOT TO SCALE
BUNGALOW FOUNDATION DETAILS
APPIN ASSOC. INC.
A2

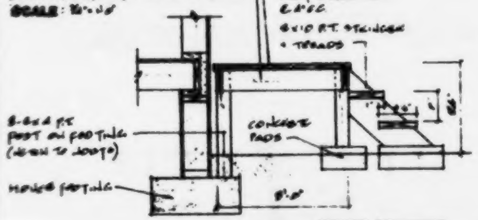

TRUSS TOP CHORD
TRUSS BOTTOM CHORD
MAINTAIN AIRFLOW 2x2 INSULATION STOP
2x2 SOFFIT NAILER BLOCKING
CARDBOARD INSULATION STOP + WIND SHIELD
2 - 6" (R2) LAYERS OF BATT INSULATION TOTAL EQUALS 12" (R-40)
CONTINUOUS 2x4 TRUSS TIE + SOFFIT NAILER
2x6 STUDS
2x6 TOP PLATE
2x6 PLATE
2" RIGID INSULATION

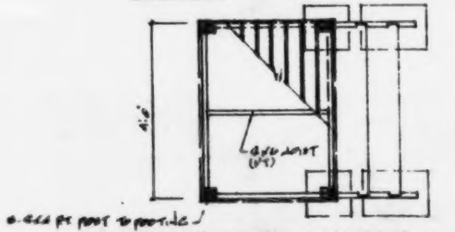
SOFFIT VENTING DETAIL

NOT TO SCALE

LANDING DETAIL

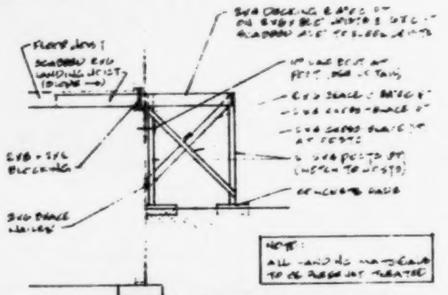
SCALE : ⅜"=1'-0"


2x6 JOISTS @ 24" O.C. PT
2x4 PT DECKING @ 24" O.C.
2x10 PT STRINGER + TREADS
CONCRETE PADS
HOUSE FOOTING
8'-0"


2x6 JOIST (PT)
4'-0"

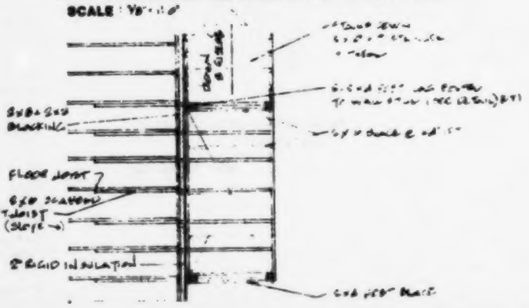
PLAN VIEW OF LANDING

SCALE : ⅜"=1'-0"


FLOOR JOIST
2x6 + 2x6 BLOCKING
2x6 BRACE NAILER
CONCRETE PADS
NOTE:
ALL LANDING MATERIALS TO BE PRESSURE TREATED

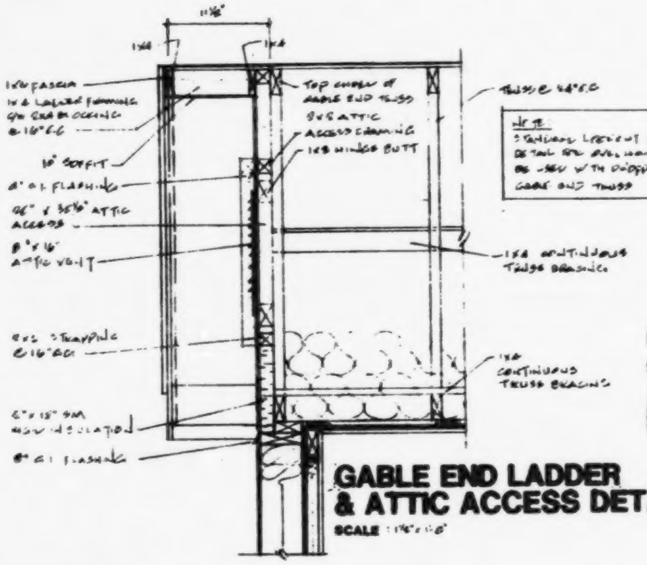
BI-LEVEL LANDING DETAIL

SCALE : ⅜"=1'-0"


2x6 & 2x6 BLOCKING
FLOOR JOIST
2" RIGID INSULATION

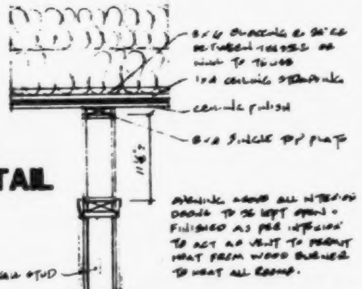
PLAN VIEW OF BI-LEVEL LANDING

SCALE : ⅜"=1'-0"


11⅛"
1x4 FASCIA
TOP CHORD OF GABLE END TRUSS
2x6 ATTIC ACCESS
10" SOFFIT
8" G.I. FLASHING
ATTIC ACCESS
ATTIC VENT
TRUSS @ 24" O.C.
1x4 CONTINUOUS TRUSS BRACING
1x4 CONTINUOUS TRUSS BRACING
8" G.I. FLASHING
NOTE
STANDARD LOOKOUT LADDER DETAIL SEE ENGLISHING MAY BE USED WITH DIFFERENT GABLE END TRUSS

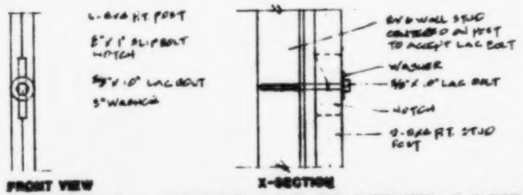
GABLE END LADDER & ATTIC ACCESS DETAIL

SCALE : 1½"=1'-0"


1x4 CEILING STRAPPING
CEILING FINISH
2x4 SINGLE TOP PLATE
OPENING ABOVE ALL INTERIOR DOORS TO BE LEFT OPEN + FINISHED AS PER INTERIOR TO ACT AS VENT TO PERMIT HEAT FROM WOOD BURNER TO HEAT ALL ROOMS.
WALL STUD

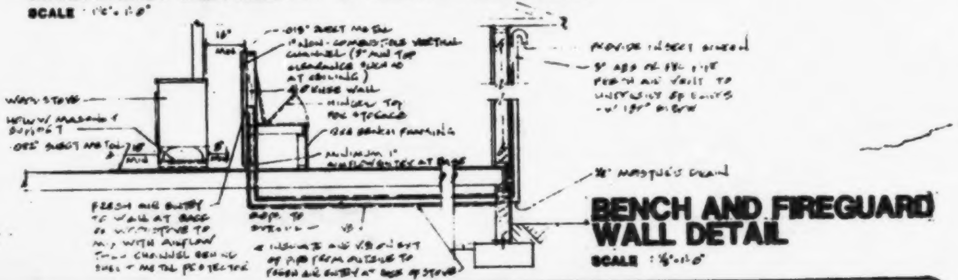
INTERIOR ROOM VENT

SCALE : 1½"=1'-0"


WASHER
NOTCH
FRONT VIEW
X-SECTION

LAG BOLT DETAIL AT BI-LEVEL LANDING

SCALE : 1½"=1'-0"


WOOD STOVE
FRESH AIR ENTRY TO WALL AT BACK OF WOODSTOVE TO MIX WITH AIRFLOW THRU CHANNEL BEHIND SHEET METAL PROTECTOR
INSULATE AND VB ON OUT OF PIPE FROM OUTSIDE TO FRESH AIR ENTRY AT BACK OF STOVE
PROVIDE INSECT SCREEN
MASTIC'S DRAIN

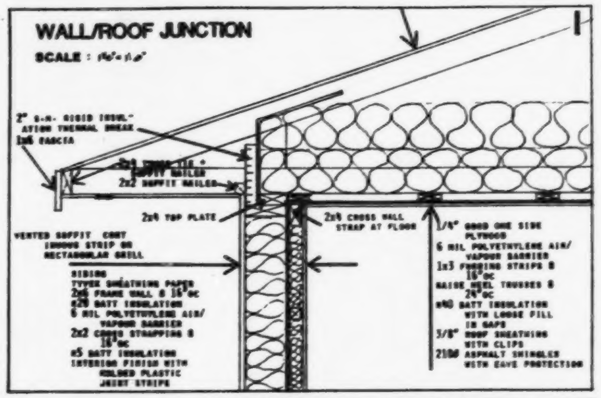
BENCH AND FIREGUARD WALL DETAIL

SCALE : ½"=1'-0"

CONSTRUCTION DETAILS

APPIN ASSOC. INC.

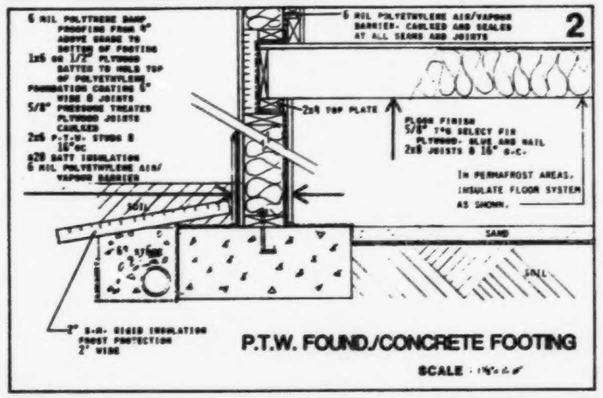
3



WALL/ROOF JUNCTION

SCALE : 1½" = 1'-0"

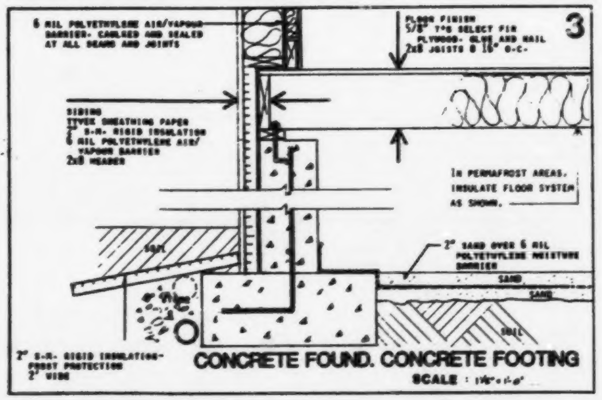
1
2" S-R- RIGID INSUL-ATION THERMAL BREAK
1x6 FASCIA
2x4 CROSS TIE + SOFFIT NAILER
2x2 SOFFIT NAILER
2x4 TOP PLATE
VENTED SOFFIT CONT INUOUS STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16"OC
#20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16"OC
#5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
2x4 CROSS WALL STRAP AT FLOOR
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
1x3 FURRING STRIPS @ 16"OC
RAISE HEEL TRUSSES @ 24"OC
#40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION



P.T.W. FOUND./CONCRETE FOOTING

SCALE : 1½" = 1'-0"

2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"OC
#20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
SAND
6" STONE
2" S-R- RIGID INSULATION FROST PROTECTION 2' WIDE



CONCRETE FOUND. CONCRETE FOOTING

SCALE : 1½" = 1'-0"

3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
SIDING
TYVEK SHEATHING PAPER
2" S-R- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SOIL
SAND
2" S-R- RIGID INSULATION- FROST PROTECTION 2' WIDE

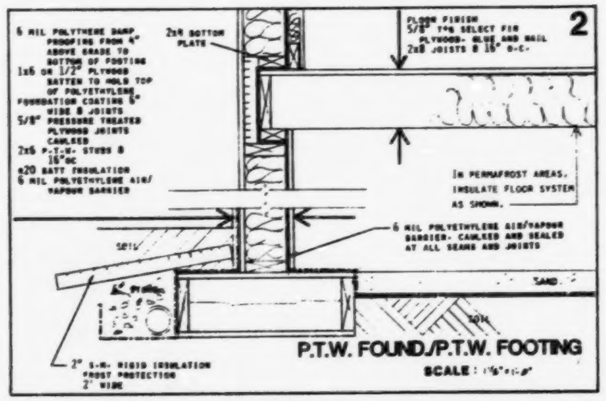
1 The use of raised heel trusses allows increased levels of insulation in the ceiling along the outside walls, reducing condensation problems in this area. The insulation retainer and wind break is made of cardboard. It is stapled between the rafters. It prevents wind from blowing through the insulation along the soffits and it holds the insulation away from the roof sheating, allowing air flow for attic ventilation. The 1 x 3 ceiling strapping retains the attic insulation during construction and provides a nailing strip for the ceiling finish.

2 This detail shows vapour barrier placement for the junction between the first floor and a preserved wood foundation. After the foundation wall has been constructed, a strip of 6 mil poly two feet wide is placed over the lower top plate. About 6 inches of the poly hangs down the inside of the wall, the remainder hangs down on the outside of the wall. The upper top plate is then installed, holding the poly in place during construction of the floor assembly. The poly strip on the outside of the rim joist or joist header is wrapped around the rim joist and over the floor prior to erection of the upper wall. The upper wall is placed on this poly strip. When the wall vapour barriers are installed, caulk them to the rim joist vapour barrier using acoustical sealant. Do not insulate the space inside the rim joist.

3 Frame wall overhangs joist header and concrete crawl space wall by 2". 6 mil poly vapour barrier runs under bottom plate of frame wall and on the crawl space wall, to the footing. 2" of rigid insulation is placed over the vapour barrier. Do not insulate inside of joist header. At footing, rigid insulation is extended horizontally 2 feet to provide a thermal break. Groundsheet in crawl space is required for moisture control. It is held in place and protected by a layer of sand or fine soil.

Unheated crawl space is only recommended where house is located on permafrost. The plywood floor sheating serves as the floor vapour barrier. Caulk the wall vapour barrier to the floor sheating and caulk the seams between the sheets of plywood. A 6 mil poly groundsheet is located under the house and protected with a layer of sand.

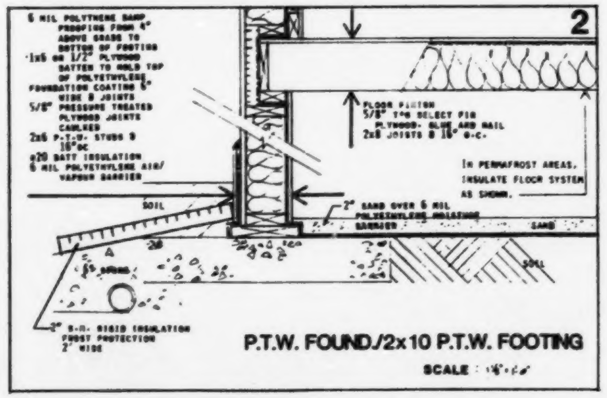
The minimum depth of foundations sited on clays or soils not clearly defined shall be 4 feet unless experience with local soil conditions show that lesser depths are satisfactory. (Section 9.12 National Building Code).



P.T.W. FOUND./P.T.W. FOOTING

SCALE : 1½" = 1'-0"

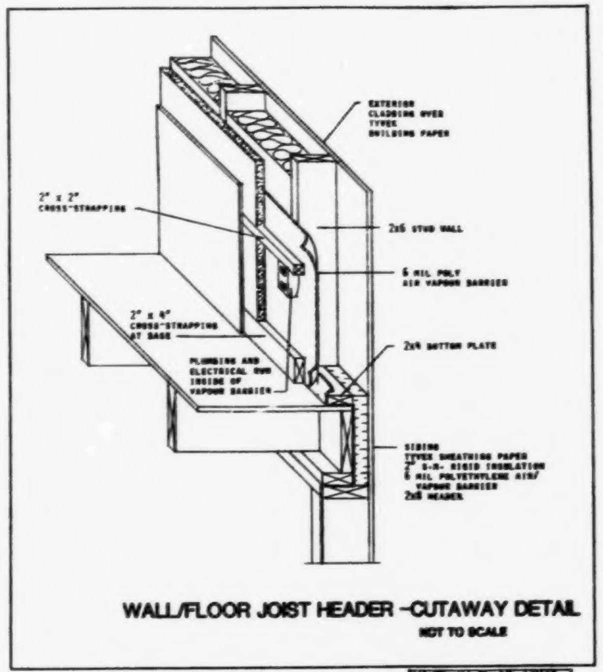
2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"OC
#20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x4 BOTTOM PLATE
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SOIL
SAND
2" S-R- RIGID INSULATION FROST PROTECTION 2' WIDE



P.T.W. FOUND./2x10 P.T.W. FOOTING

SCALE : 1½" = 1'-0"

2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"OC
#20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SOIL
SAND
2" S-R- RIGID INSULATION FROST PROTECTION 2' WIDE



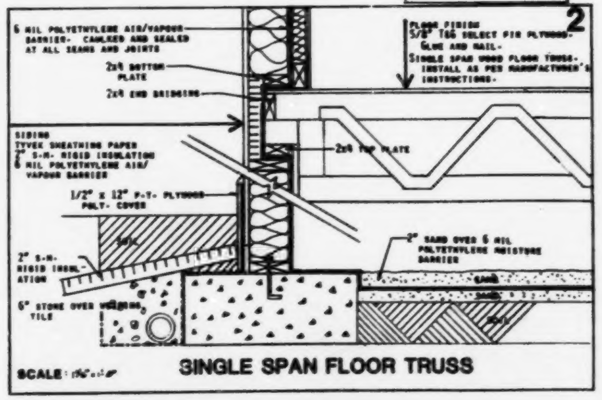
WALL/FLOOR JOIST HEADER -CUTAWAY DETAIL

NOT TO SCALE

EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
2x4 BOTTOM PLATE
SIDING
TYVEK SHEATHING PAPER
2" S-R- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER

NOTE: ALL FLOOR COVER CHANGED TO:

FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD OR 5/8" T+G STD. SPRUCE PLY. C/W 5/16" STD. PLY. UNDERLAY. GLUE + NAIL
2x8 JOISTS @ 16" O.C.



SINGLE SPAN FLOOR TRUSS

SCALE : 1½" = 1'-0"

2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
SIDING
TYVEK SHEATHING PAPER
2" S-R- RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
1/2" x 12" P.T. PLYWOOD POLY. COVER
2" S-R- RIGID INSUL-ATION
6" STONE OVER WEEPING TILE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS. INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
2x4 TOP PLATE
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SOIL
SAND

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS [illegible] ELECTRICAL AND OTHER SERVICES. [illegible] DIFFERENT CONDITIONS EXIST, [illegible] RESPONSIBILITY OF THE [illegible] AUTHORITY TO [illegible] THE DESIGNS AS NECESSARY.

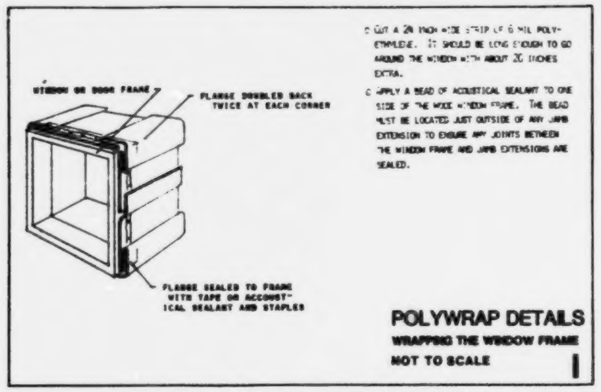
BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS

UNIES Ltd

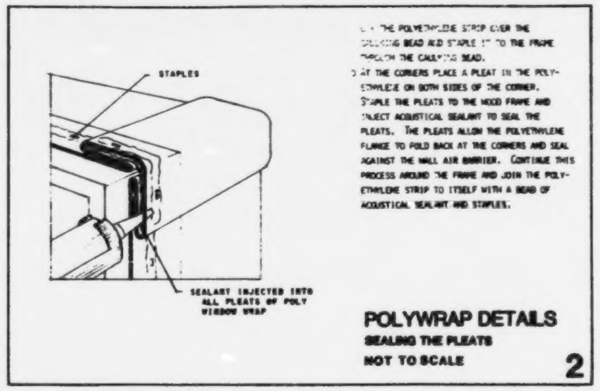
APPIN ASSOC. INC.
13-77 RUE EUGENIE
WPG. MAN.

4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACCOUSTICAL SEALANT AND STAPLES

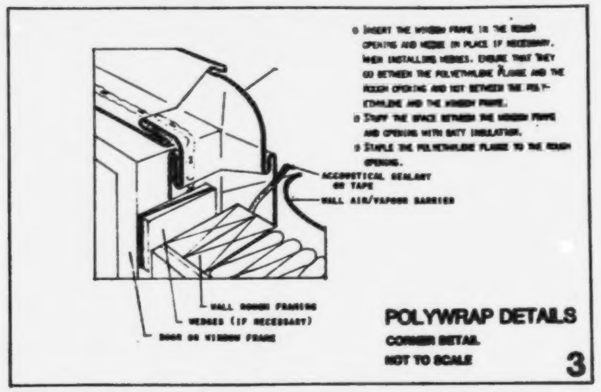
- CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO ONE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE **1**


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

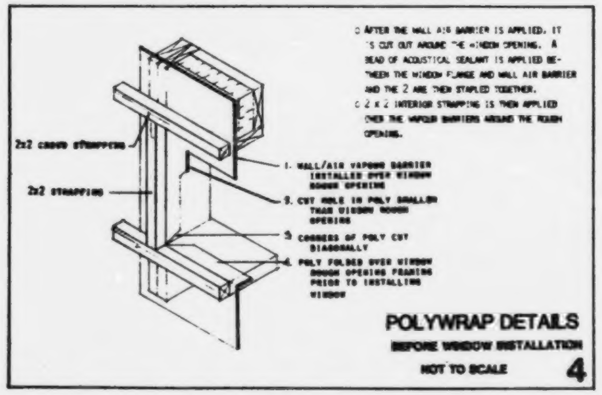
- LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE **2**


ACCOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

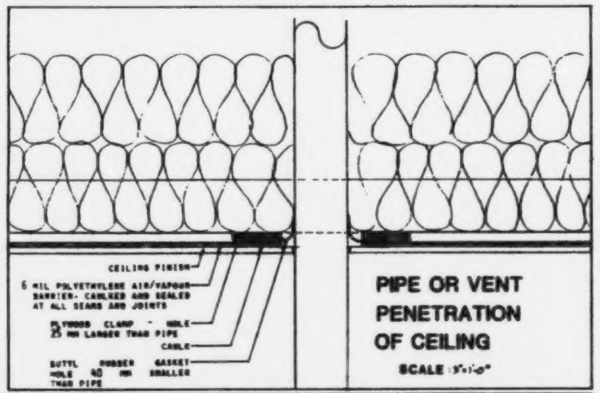
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE **3**

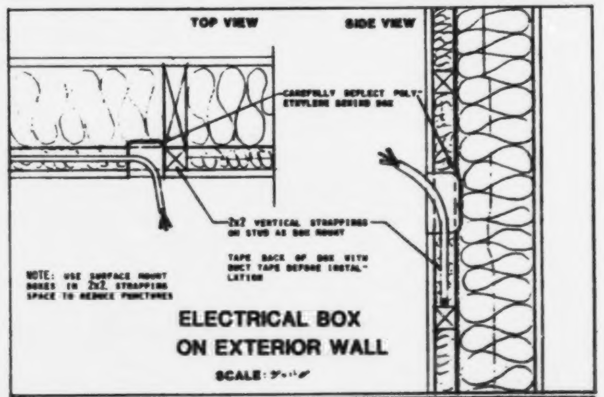

2x2 CROSS STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 X 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE **4**

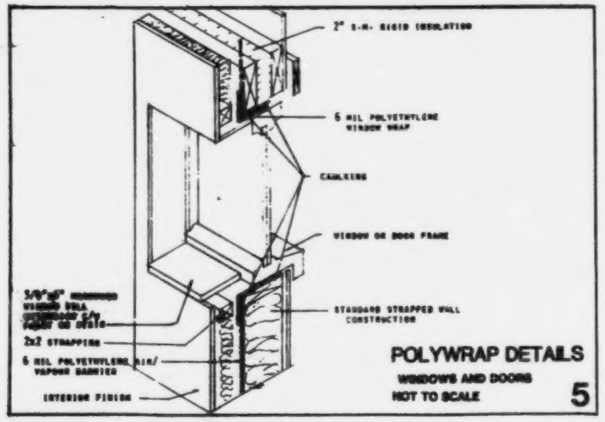

CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CABLE
BUTYL RUBBER GASKET HOLE 40 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE : 3"=1'-0"

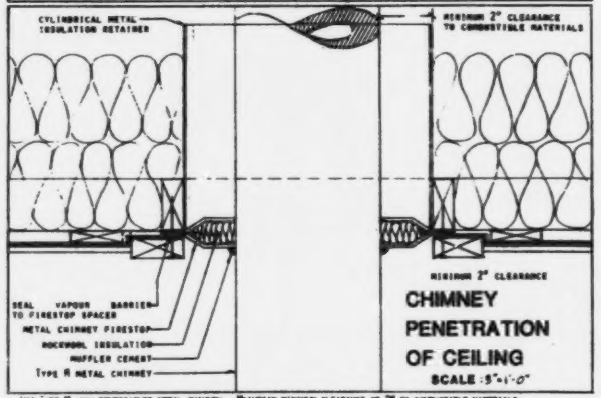

TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPINGS ON STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION

NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE : 3"=1'-0"

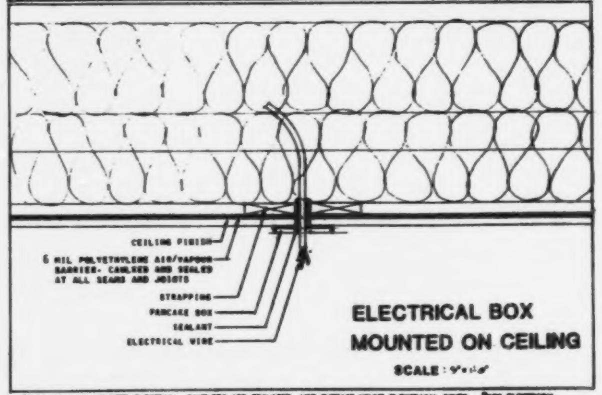

2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
3/4"x6" [illegible] WINDOW SILL [illegible] PAINT OR STAIN
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE **5**


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY
MINIMUM 2" CLEARANCE

CHIMNEY PENETRATION OF CEILING
SCALE : 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE : 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

[illegible]

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CONSTRUCTION & ENGINEERING DETAILS

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13-77 [illegible]
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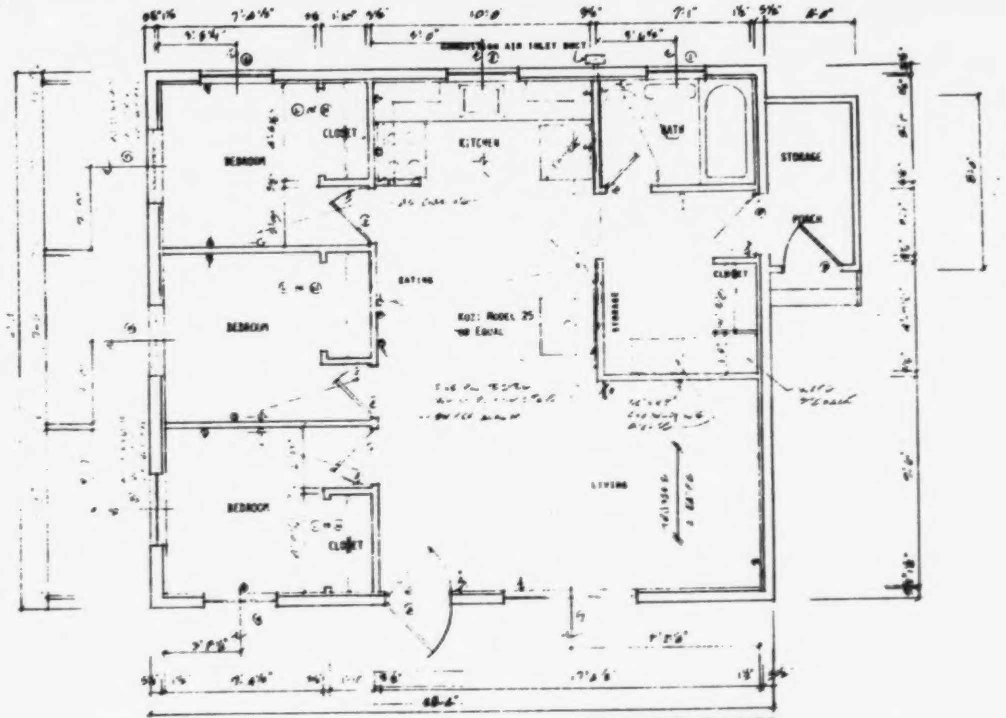
5

3.3.3 Plan "C" (3 bedroom version) Design Features

- This plan is similar to Plan "B" without a utility/storage room, thus creating a larger living room.
- The incorporation of three bedrooms along the width of the house instead of just two. The homeowner sacrifices the original spaciousness of the two bedroom design in order to accommodate three bedrooms.
- While no interior wood storage area has been specified in any of the 3 plans, the utility/storage spaces could be used for this purpose if so desired by the homeowner.


BEDROOM
CLOSET
KITCHEN
BATH
STORAGE
PORCH
CLOSET
EATING
BEDROOM
STORAGE
LIVING
BEDROOM
CLOSET
48'-6"

FLOOR PLAN

SCALE 1/4" = 1'-0"

DOOR SCHEDULE

	DOOR SIZE	ROUGH OPENING	STYLE
A B	[illegible]		WOOD COMBINATION
C D	[illegible]	[illegible]	INSULATED WOOD ROTARY MAHOGANY
E F G H	[illegible]	[illegible]	HOLLOW CORE ROTARY MAHOGANY
J K L M	[illegible]	[illegible]	BI-FOLD SLAB ROTARY MAHOGANY
N P	[illegible]	[illegible]	BY-PASS SLIDING ROTARY MAHOGANY

WINDOW SCHEDULE

	GLASS SIZE	ROUGH OPENING
1	[illegible]	[illegible]
2	[illegible]	[illegible]
3	[illegible]	[illegible]
4	[illegible]	[illegible]
5	[illegible]	[illegible]
6	[illegible]	[illegible]
7	[illegible]	[illegible]

WINDOW SIZES ARE FOR PROPRIETARY SEALED DOUBLE-GLAZED WINDOWS. IF OTHER WINDOWS ARE USED ADJUST ROUGH OPENING SIZE ACCORDINGLY.

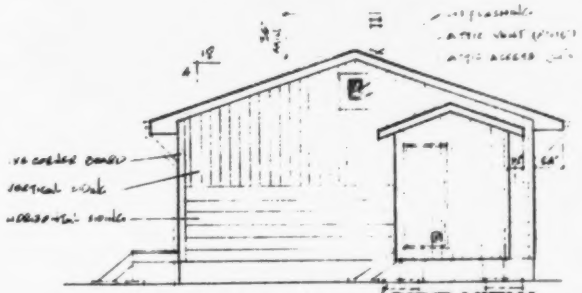
G.I. FLASHING OVER EXTERIOR OPENINGS

2 x 10 LINTELS OVER ALL WINDOW OPENINGS.

EXTERIOR SIDING ALTERNATIVES ARE
- 3/8" WAFERBOARD + TYVEC + 3/8" HARDBOARD
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

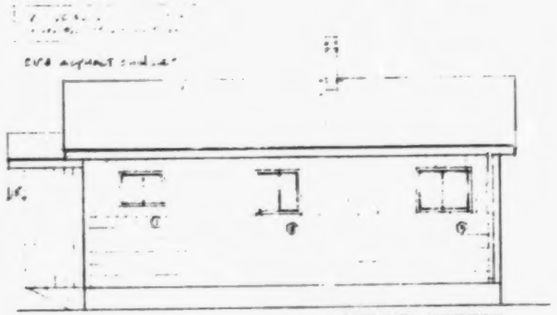
G.I. flashing at all horizontal joints of panel type exterior siding


1x6 corner board
vertical siding
horizontal siding
attic vent

* where req. by local heating code – place optional 36" x 36" combo and air adjustable thermostat

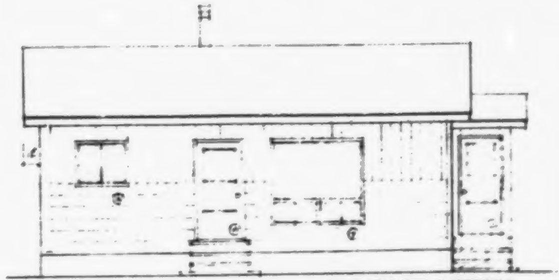
SIDE VIEW

SCALE 1/4" = 1'-0"



REAR VIEW

SCALE 1/4" = 1'-0"



FRONT VIEW

SCALE 1/4" = 1'-0"

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THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS [illegible]

24 x 28 BUNGALOW
3 BEDROOM

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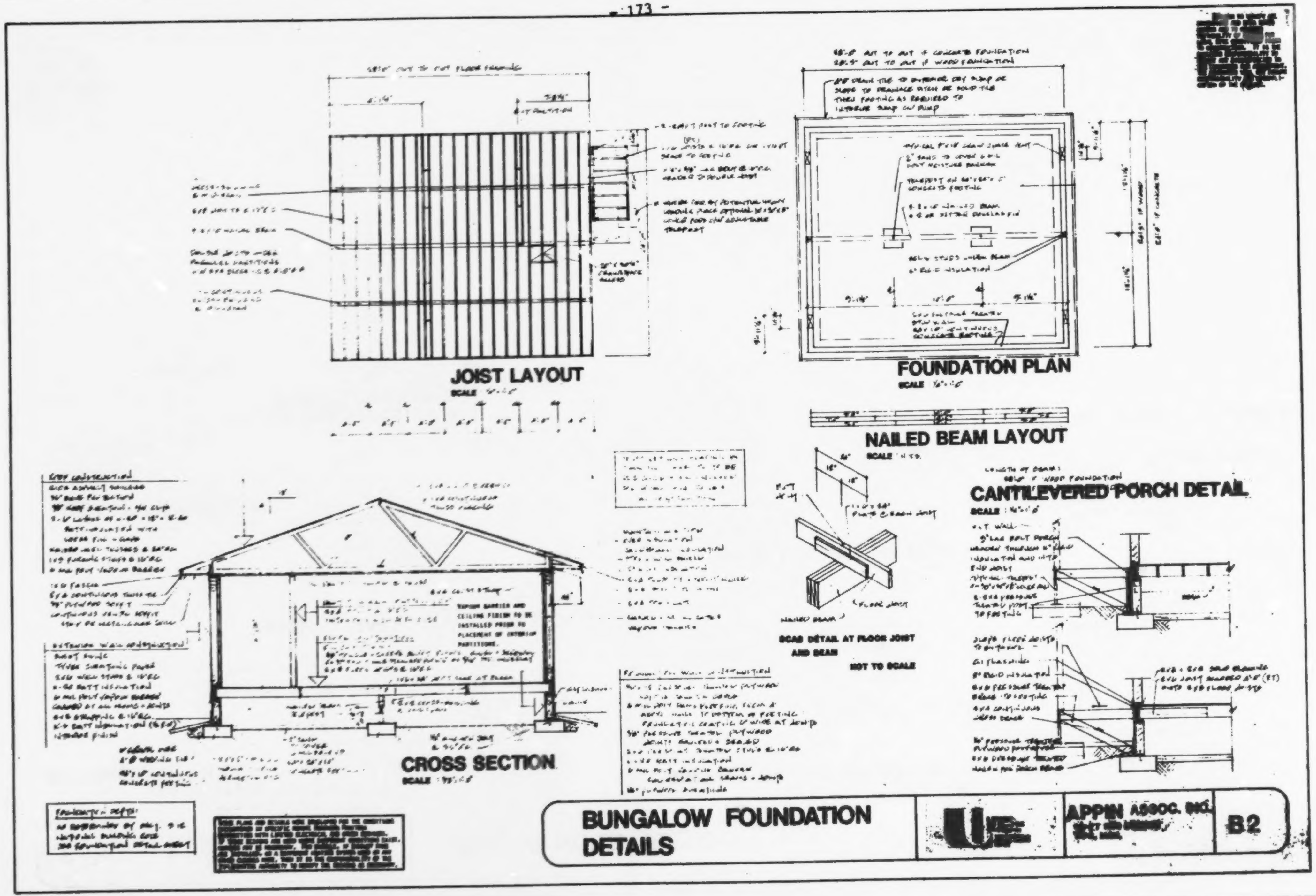
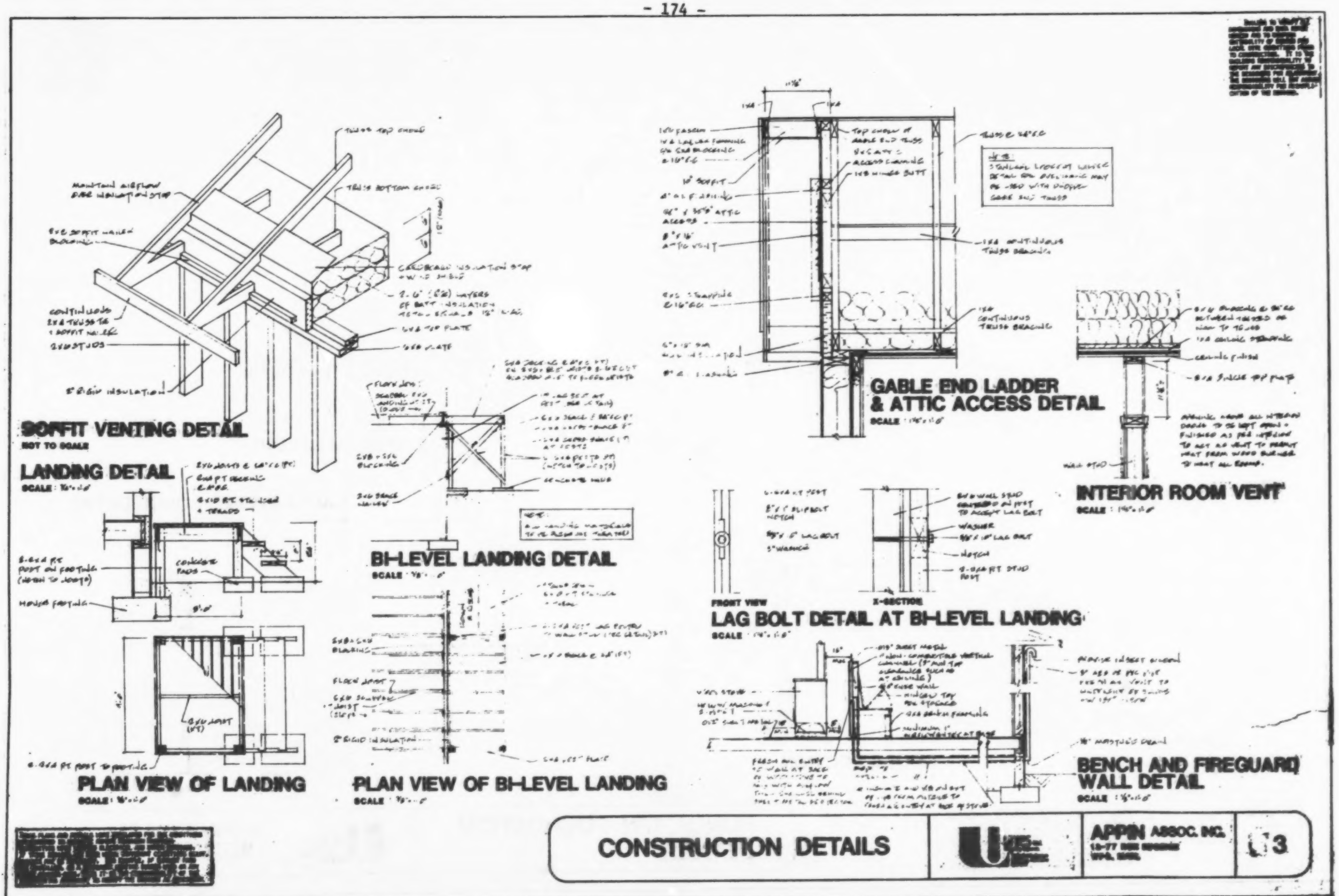
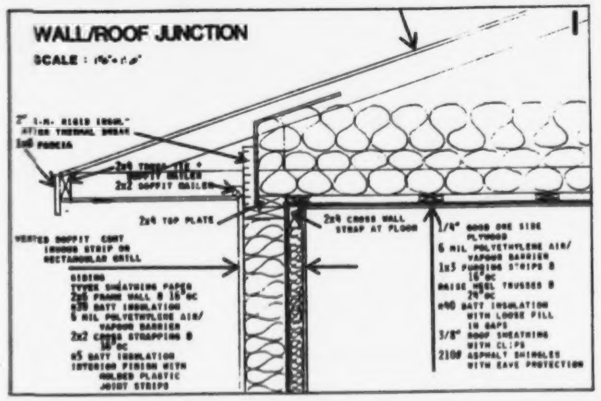
B1


JOIST LAYOUT
SCALE
FOUNDATION PLAN
SCALE
NAILED BEAM LAYOUT
SCALE
FLOOR JOIST
NAILED BEAM
SCAB DETAIL AT FLOOR JOIST AND BEAM
NOT TO SCALE
CANTILEVERED PORCH DETAIL
SCALE
CROSS SECTION
SCALE
VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.
BUNGALOW FOUNDATION DETAILS
APPIN ASSOC. INC.
B2


TRUSS TOP CHORD
MOUNTAIN AIRFLOW EAVE INSULATION STOP
TRUSS BOTTOM CHORD
2X2 SOFFIT NAILER BLOCKING
CARDBOARD INSULATION STOP + WIND SHIELD
2-6" (R20) LAYERS OF BATT INSULATION
CONTINUOUS 2X4 TRUSS TIE + SOFFIT NAILER
2X6 STUDS
2X6 TOP PLATE
2X6 PLATE
2" RIGID INSULATION
SOFFIT VENTING DETAIL
NOT TO SCALE
LANDING DETAIL
SCALE
CONCRETE PADS
HOUSE FOOTING
PLAN VIEW OF LANDING
SCALE
FLOOR JOIST
2" RIGID INSULATION
NOTE:
BI-LEVEL LANDING DETAIL
SCALE
PLAN VIEW OF BI-LEVEL LANDING
SCALE
1X4
1X4 FASCIA
10" SOFFIT
TOP CHORD OF GABLE END TRUSS
ACCESS CHANNEL
1X3 HINGE BUTT
TRUSS @ 24" O.C.
NOTE:
1X4 CONTINUOUS TRUSS BRACING
1X4 CONTINUOUS TRUSS BRACING
GABLE END LADDER & ATTIC ACCESS DETAIL
SCALE
CEILING FINISH
WALL STUD
INTERIOR ROOM VENT
SCALE
WASHER
NOTCH
FRONT VIEW
X-SECTION
LAG BOLT DETAIL AT BI-LEVEL LANDING
SCALE
BENCH AND FIREGUARD WALL DETAIL
SCALE
CONSTRUCTION DETAILS
APPIN ASSOC. INC.
C3


WALL/ROOF JUNCTION

SCALE : 1½" = 1'-0"

I
2" S.M. RIGID INSUL-ATION THERMAL BREAK
1x6 FASCIA
2x4 TRUSS TIE + SOFFIT NAILER
2x2 SOFFIT NAILER
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONT. ROUND STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
#20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
#5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" OC
RAISE HEEL TRUSSES @ 24" OC
#40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION

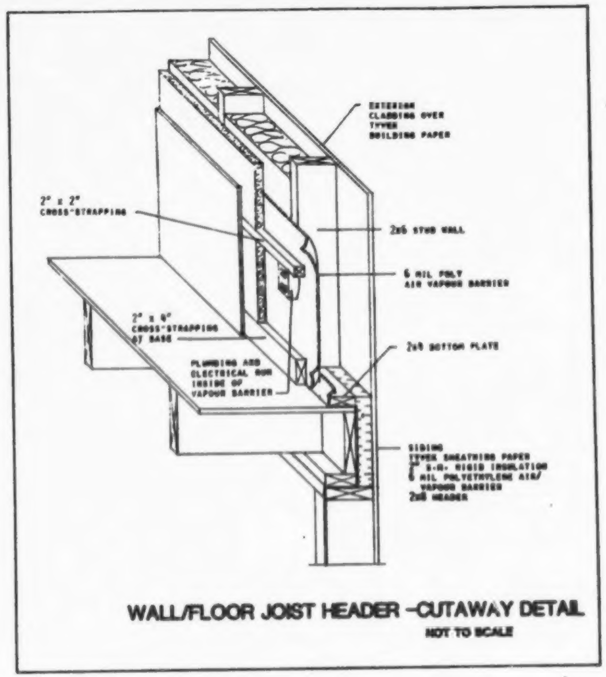
1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 x 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR INTERMEDIATE FLOOR JUNCTIONS. AFTER THE LOWER WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL, THE REMAINDER OVER THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL RESTS ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

3 UNHEATED CRAWL SPACE IS ONLY RECOMMENDED WHERE HOUSE IS LOCATED ON PERMAFROST. THE PLYWOOD FLOOR SHEATING SERVES AS THE FLOOR VAPOUR BARRIER. CAULK THE WALL VAPOUR BARRIER TO THE FLOOR SHEATING AND CAULK THE SEAMS BETWEEN THE SHEETS OF PLYWOOD. A 6 MIL POLY "GROUNDSHEET" IS LOCATED UNDER THE HOUSE AND PROTECTED WITH A LAYER OF SAND.

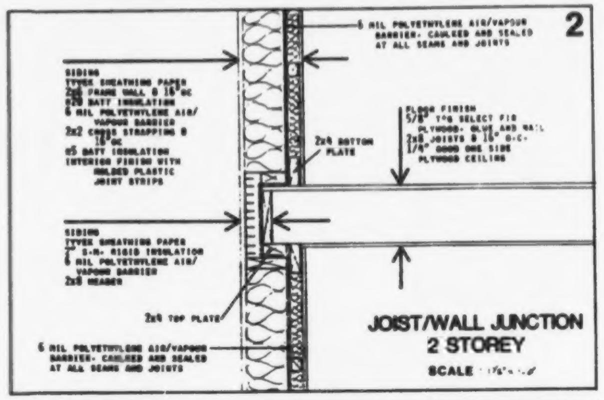
THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. PASS ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.


WALL/FLOOR JOIST HEADER -CUTAWAY DETAIL

NOT TO SCALE

EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 6" CROSS-STRAPPING AT BASE
2x6 BOTTOM PLATE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER

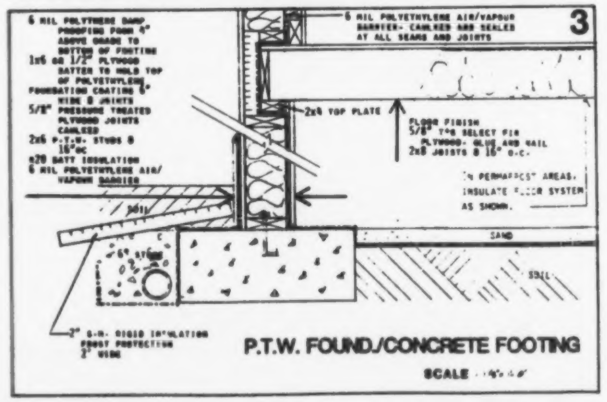

JOIST/WALL JUNCTION 2 STOREY

SCALE : 1½" = 1'-0"

2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
#20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
#5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
2x4 BOTTOM PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD, GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
1/4" GOOD ONE SIDE PLYWOOD CEILING
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER
2x4 TOP PLATE
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS

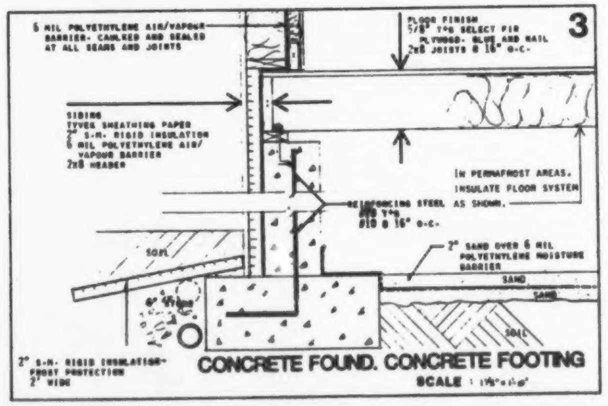
NOTE ALL FLOOR JOIST [illegible]

FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD OR 5/8" T&G STD. SPRUCE PLY. C/W 5/16" STD. PLY. UNDERLAY. GLUE & NAIL
2x8 JOISTS @ 16" O.C.


P.T.W. FOUND./CONCRETE FOOTING

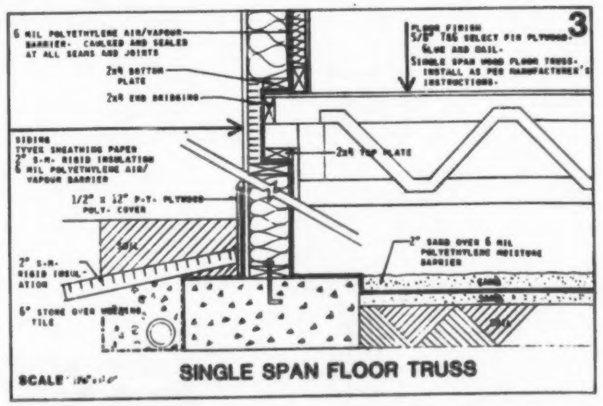
SCALE : 1½" = 1'-0"

3
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTER TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
#20 BATT INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD, GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
6" STONE
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE


CONCRETE FOUND. CONCRETE FOOTING

SCALE : 1½" = 1'-0"

3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x8 HEADER
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD, GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
REINFORCING STEEL AND T&G #10 @ 16" O.C.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SOIL
6" STONE
SAND
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE


SINGLE SPAN FLOOR TRUSS

SCALE : 1½" = 1'-0"

3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD, GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS. INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/ VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P.T. PLYWOOD POLY. COVER
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
2" S.M. RIGID INSULATION
6" STONE OVER WEEPING TILE
SOIL
SAND
SAND
SOIL

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS [illegible] IN SPECIFIC [illegible] [illegible] WITH [illegible] AND OTHER [illegible]. IF THESE DRAWINGS ARE USED WHERE DIFFERENT CONDITIONS EXIST, CHANGES MAY BE NECESSARY. FOR EXAMPLE, IF [illegible] [illegible], THEN IT IS THE RESPONSIBILITY OF THE [illegible] AUTHORITY TO MODIFY THE DESIGNS AS NECESSARY.

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION &
ENGINEERING DETAILS

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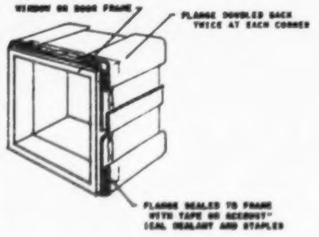
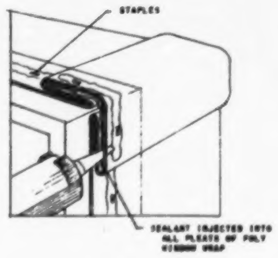
APPIN ASSOC. INC.
13-77 RUE EUGENIE
WPG. MAN.

4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

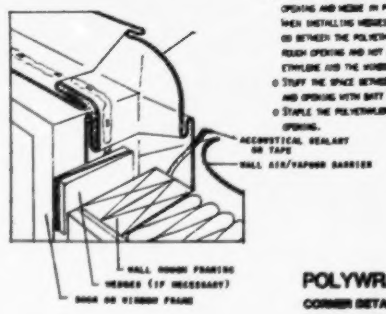
- CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO ONE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

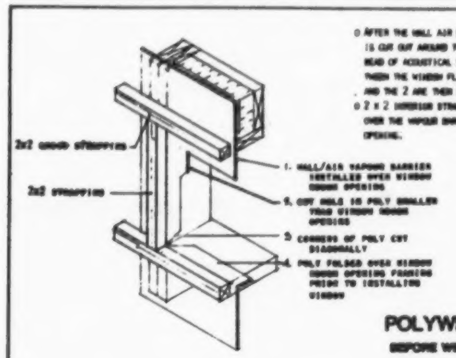
- LAP THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2


ACOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

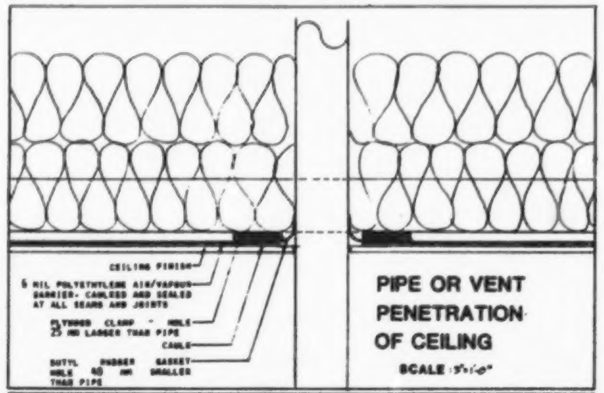
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3


2x2 WOOD STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

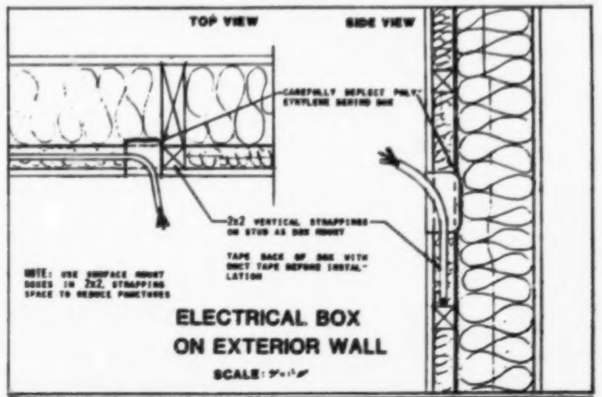
- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 x 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 40 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING

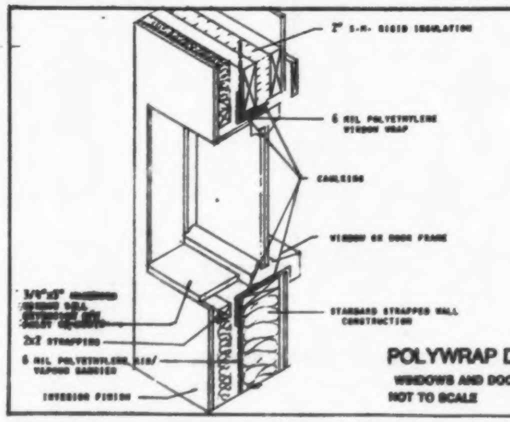
SCALE: 5"=1'-0"


TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPINGS ON STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION

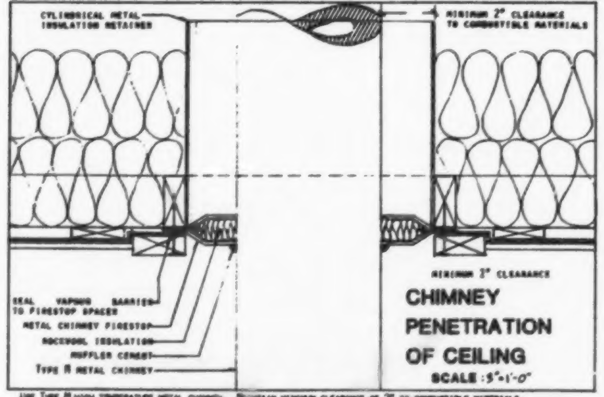
NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL

SCALE: 5"=1'-0"


2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
3/4"x3" [illegible]
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

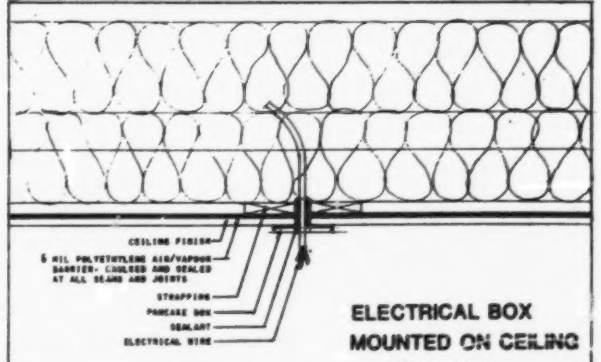
POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE
5


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
MINIMUM 2" CLEARANCE
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY

CHIMNEY PENETRATION OF CEILING

SCALE: 5"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING

SCALE: 5"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. PASS ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPENCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS

UNIES Ltd.

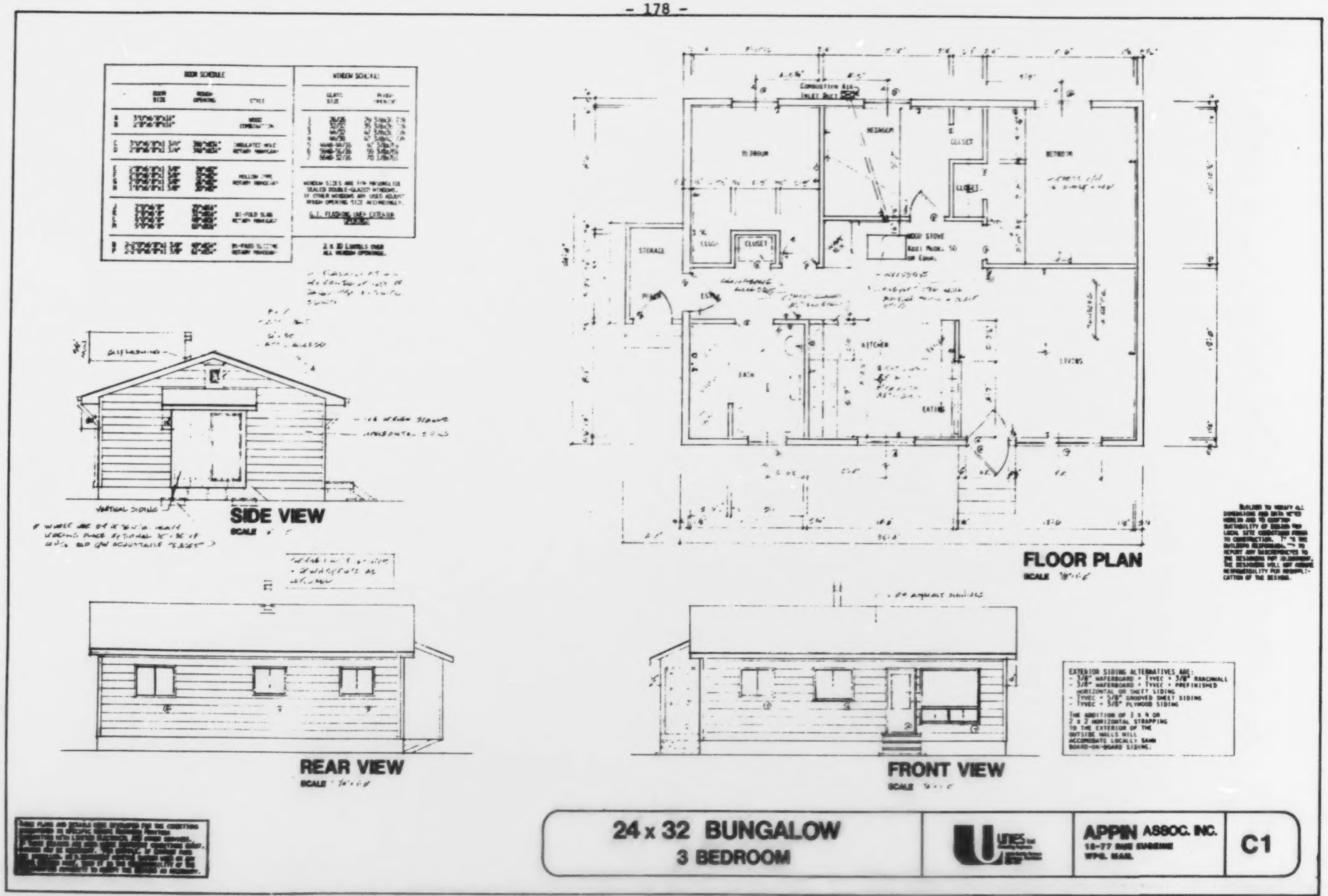
APPIN ASSOC. INC.
18-77 [illegible]
WPG. MAN.

5

3.4 24' x 32' Bungalow (3 bedroom) Design Features

There is approximately 768 sq. ft. of floor area in this design.

- There is a familiar layout, proven to have good heat distribution during the winter heating months.
- A vestibule entry is incorporated through the addition of an enclosed porch on the exterior.
- The bathroom is within ready access to the side exit.
- The wood stove is centrally located, with possible space for some wood storage beside it.
- A secondary exit is provided off of the living room.


DOOR SCHEDULE
DOOR SIZE
ROUGH OPENING
STYLE
WOOD COMBINATION
INSULATED HOLE ROTARY HANGER
HOLLOW CORE ROTARY HANGER
BI-FOLD SLAB ROTARY HANGER
BI-PASS SLIDING ROTARY HANGER
WINDOW SCHEDULE
GLASS SIZE
ROUGH OPENING
BEDROOM
BEDROOM
BEDROOM
CLOSET
CLOSET
CLOSET
STORAGE
WOOD STOVE
BATH
KITCHEN
EATING
LIVING
COMBUSTION AIR INLET DUCT
SIDE VIEW
SCALE
VERTICAL SIDING
FLOOR PLAN
SCALE
REAR VIEW
SCALE
FRONT VIEW
SCALE

WINDOW SIZES ARE FOR PREGLAZED SEALED DOUBLE-GLAZED WINDOWS. IF OTHER WINDOWS ARE USED ADJUST ROUGH OPENING SIZE ACCORDINGLY.

G.I. FLASHING OVER EXTERIOR OPENINGS

2 x 10 LINTELS OVER ALL WINDOW OPENINGS.

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR CLARIFICATION. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGN.

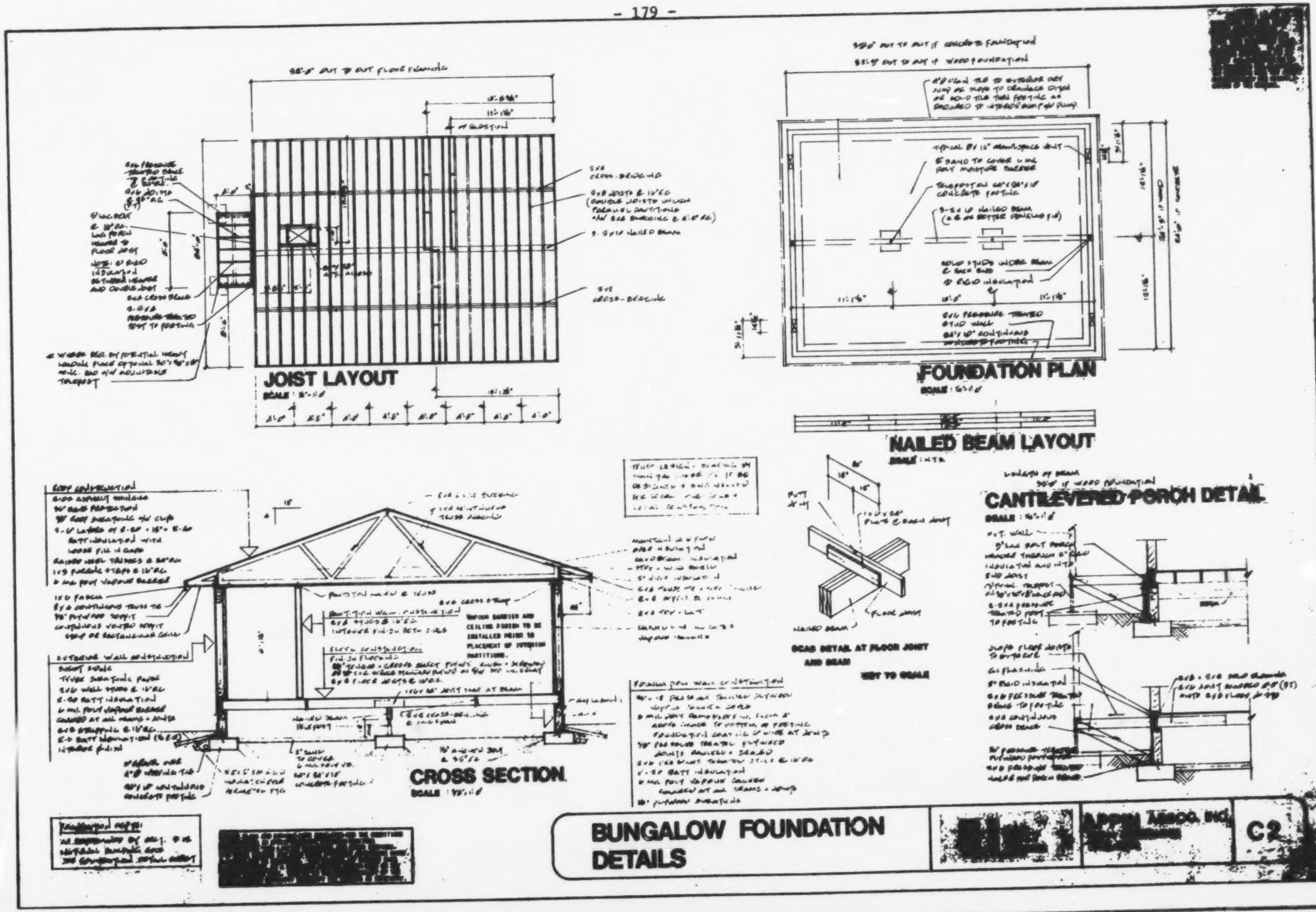
EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" WAFERBOARD + TYVEC + 3/8" RANCHWALL
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

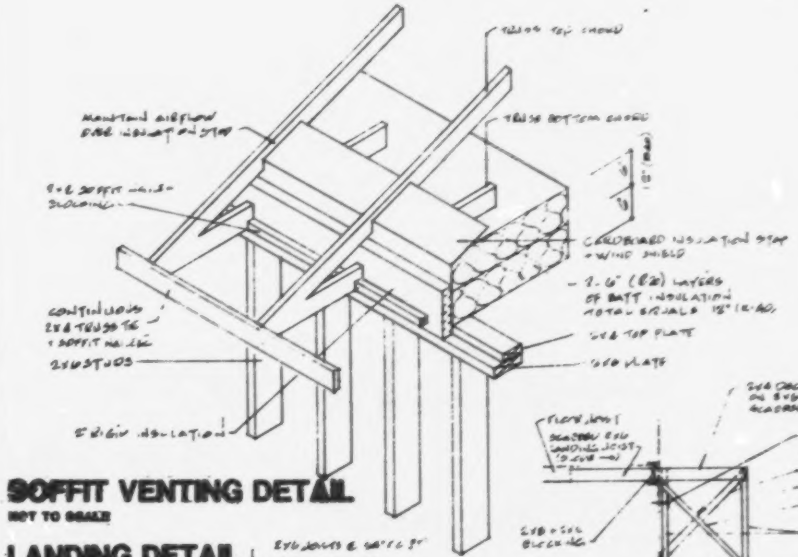
24 x 32 BUNGALOW
3 BEDROOM

APPIN ASSOC. INC.
18-77 RUE EUGENE
WPG. MAN.

C1

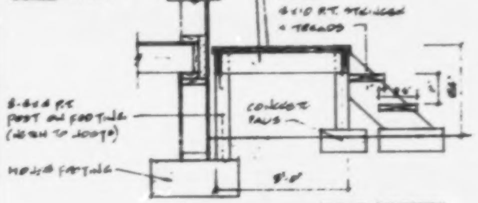

JOIST LAYOUT
FOUNDATION PLAN
NAILED BEAM LAYOUT
CANTILEVERED PORCH DETAIL
CROSS SECTION
SCAB DETAIL AT FLOOR JOIST AND BEAM
NOT TO SCALE
BUNGALOW FOUNDATION DETAILS
ASSOC. INC.
C2

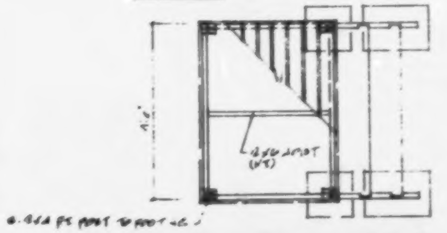
BUILDER TO VERIFY ALL DIMENSIONS AND DATA SHOWN HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDER'S RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO [illegible] RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.



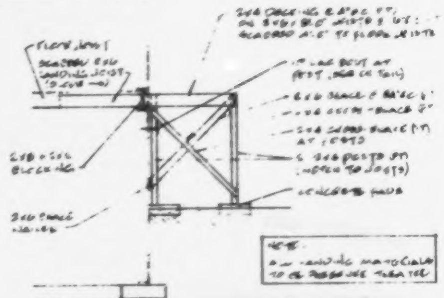
SOFFIT VENTING DETAIL
NOT TO SCALE

LANDING DETAIL
SCALE: ⅜"=1'-0"

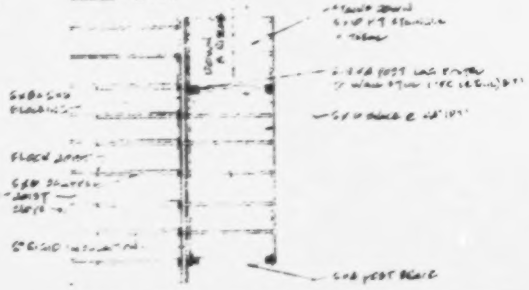




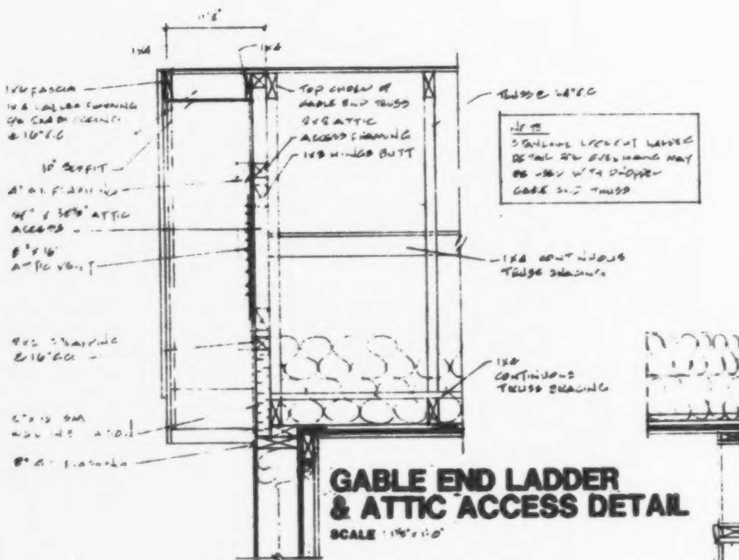
PLAN VIEW OF LANDING
SCALE: ⅜"=1'-0"



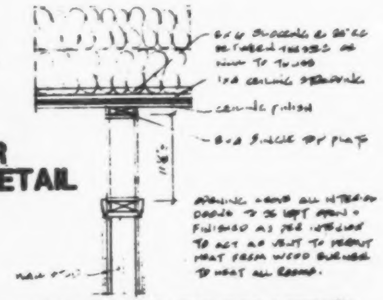
BI-LEVEL LANDING DETAIL
SCALE: ⅜"=1'-0"



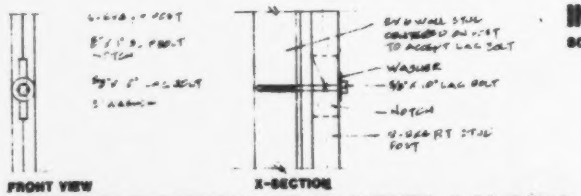
PLAN VIEW OF BI-LEVEL LANDING
SCALE: ⅜"=1'-0"



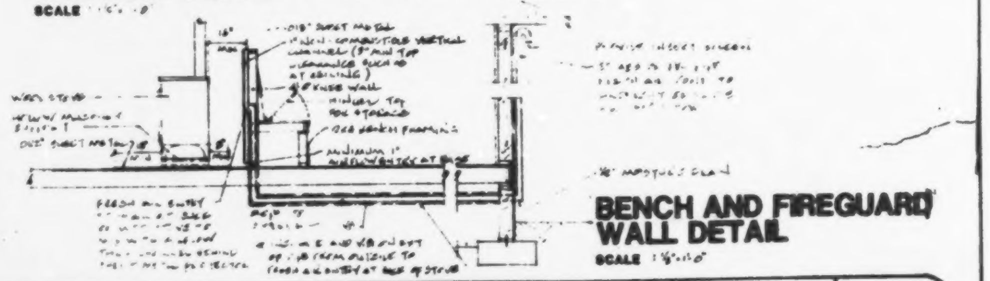
GABLE END LADDER & ATTIC ACCESS DETAIL
SCALE: 1½"=1'-0"



INTERIOR ROOM VENT
SCALE: 1½"=1'-0"



LAG BOLT DETAIL AT BI-LEVEL LANDING
SCALE: 1½"=1'-0"



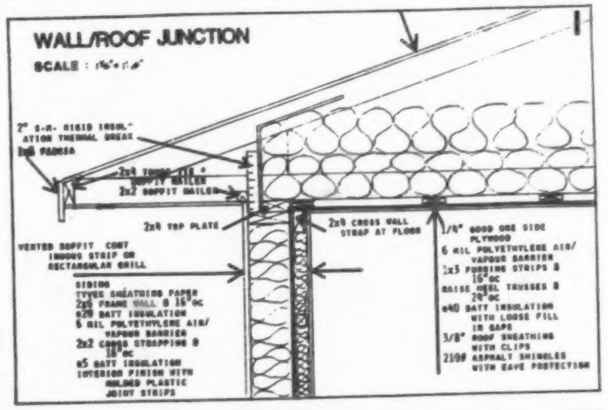
BENCH AND FIREGUARD WALL DETAIL
SCALE: ½"=1'-0"

[illegible]

CONSTRUCTION DETAILS

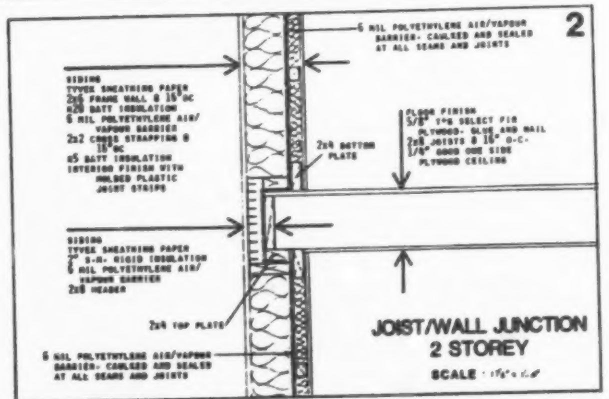
APPIN ASSOC. INC.
[illegible]

3


WALL/ROOF JUNCTION

SCALE : 1½" = 1'-0"

1
2" S.M. RIGID INSULATION THERMAL BREAK
2x6 FASCIA
2x4 TRUSS TIE & SOFFIT NAILER
2x2 SOFFIT NAILER
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONTINUOUS STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" OC
RAISE HEEL TRUSSES @ 24" OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION


JOIST/WALL JUNCTION
2 STOREY

SCALE : 1½" = 1'-0"

2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
2x4 BOTTOM PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
1/4" GOOD ONE SIDE PLYWOOD CEILING
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
2x4 TOP PLATE
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS

1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS. REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATING. ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 x 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

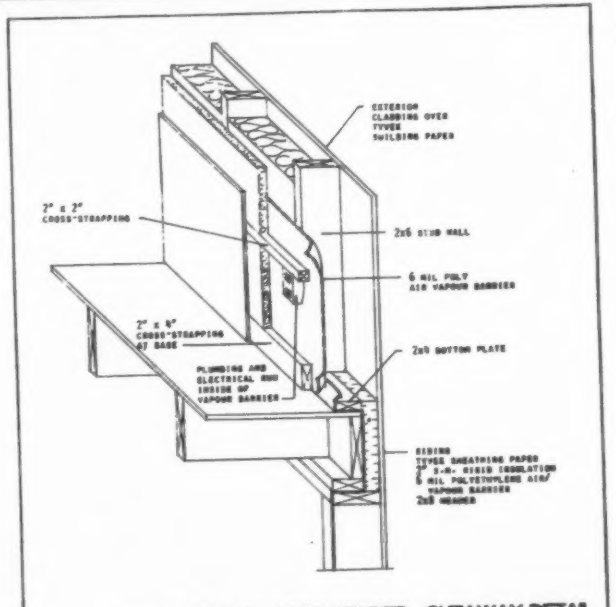
2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR INTERMEDIATE FLOOR JUNCTIONS. AFTER THE LOWER WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL. THE REMAINDER OVER THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL NESTS ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

3 UNHEATED CRAWL SPACE IS ONLY RECOMMENDED WHERE HOUSE IS LOCATED ON PERMAFROST. THE PLYWOOD FLOOR SHEATING SERVES AS THE FLOOR VAPOUR BARRIER. CAULK THE WALL VAPOUR BARRIER TO THE FLOOR SHEATING AND CAULK THE SEAMS BETWEEN THE SHEETS OF PLYWOOD. A 6 MIL POLY GROUNDSHEET IS LOCATED UNDER THE HOUSE AND PROTECTED WITH A LAYER OF SAND.

THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).

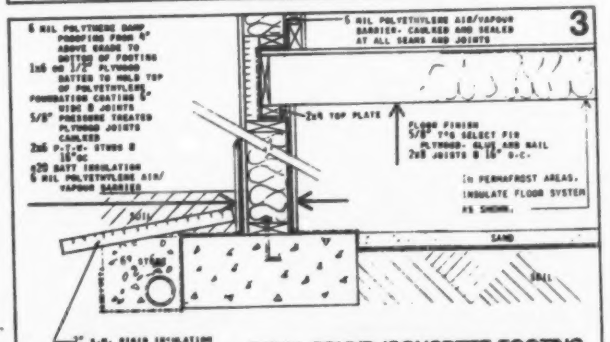
WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. PASS ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

[illegible]
FLOOR FINISH
5/8" T&G SELECT FIR
PLYWOOD OR 5/8"
T&G STD. SPRUCE PLY.
C/W 5/16" STD. PLY.
UNDERLAY. GLUE & NAIL
2x8 JOISTS @ 16" O.C.


WALL/FLOOR JOIST HEADER –CUTAWAY DETAIL

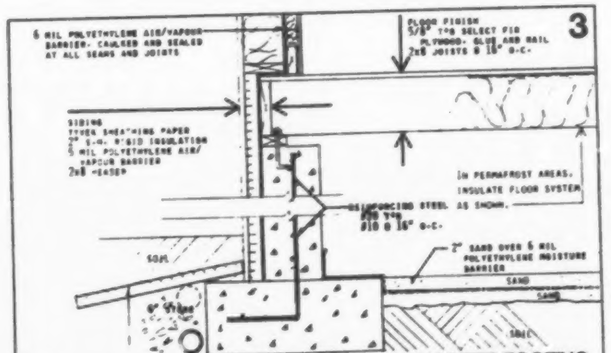
NOT TO SCALE

EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
2x4 BOTTOM PLATE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER


P.T.W. FOUND./CONCRETE FOOTING

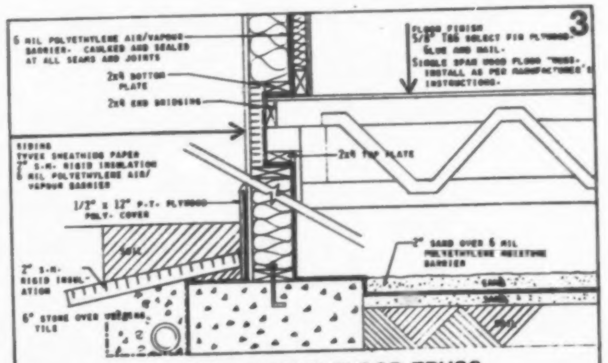
SCALE : 1½" = 1'-0"

3
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 or 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
6" STONE
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE


CONCRETE FOUND. CONCRETE FOOTING

SCALE : 1½" = 1'-0"

3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
REINFORCING STEEL AS SHOWN.
#10 @ 16" O.C.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SAND
SOIL
SOIL
6" STONE
2" S.M. RIGID INSULATION- FROST PROTECTION 2' WIDE


SINGLE SPAN FLOOR TRUSS

SCALE : 1½" = 1'-0"

3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL-
SINGLE SPAN WOOD FLOOR TRUSS- INSTALL AS PER MANUFACTURER'S INSTRUCTIONS-
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P.T. PLYWOOD POLY. COVER
SOIL
2" S.M. RIGID INSULATION
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SAND
SOIL
6" STONE OVER WEEPING TILE

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS [illegible] CONDITIONS EXIST, [illegible] IT IS THE RESPONSIBILITY OF THE [illegible] TO MODIFY THE DESIGNS AS NECESSARY.

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS

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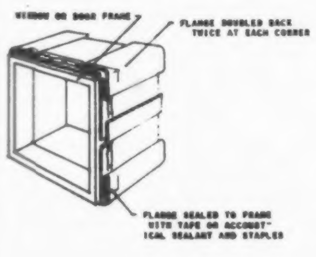
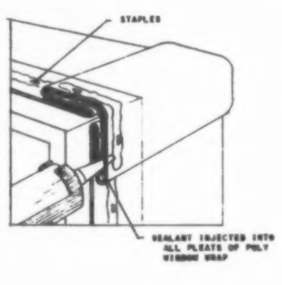
10-77 RUE EUGENIE
WPG. MAN.

4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

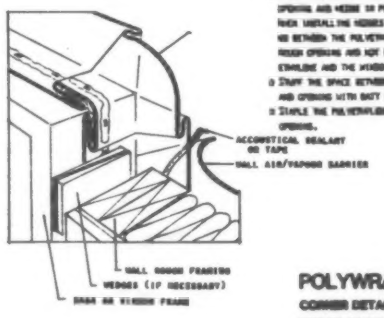
- CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO ONE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

- LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

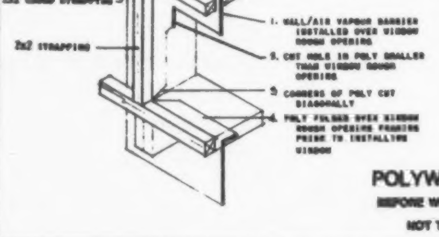
POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2


ACOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
SASH OR WINDOW FRAME

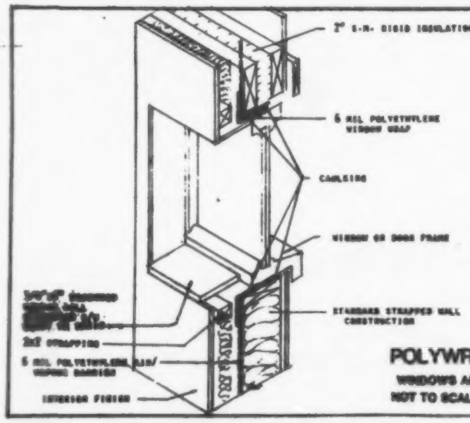
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3

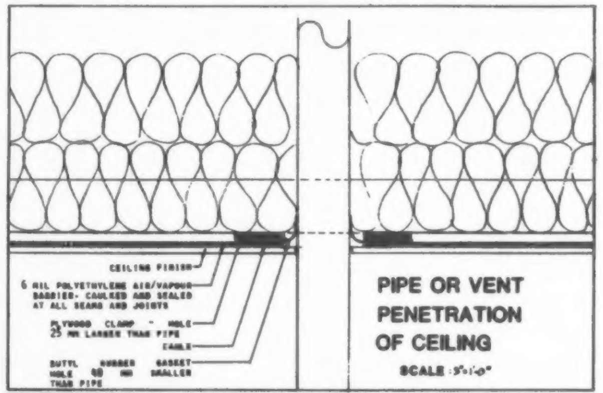
- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 X 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIER AROUND THE ROUGH OPENING.


2x2 ROUGH STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4

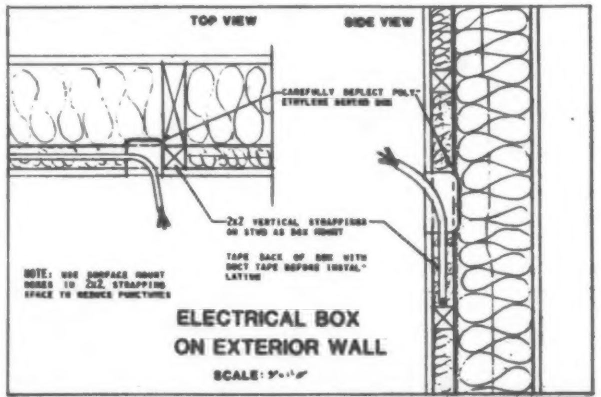

2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE
5


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 10 MM SMALLER THAN PIPE

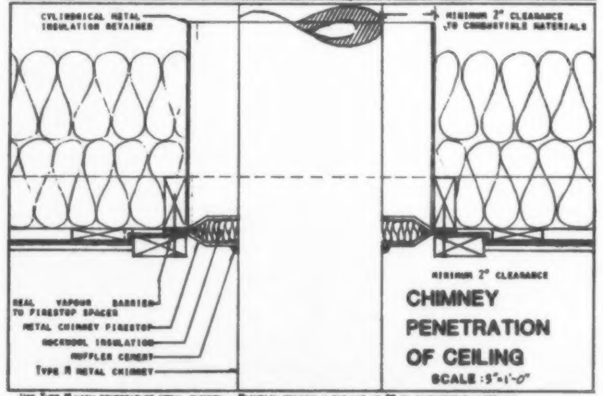
PIPE OR VENT PENETRATION OF CEILING

SCALE : 3"=1'-0"


TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPINGS ON STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION
NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL

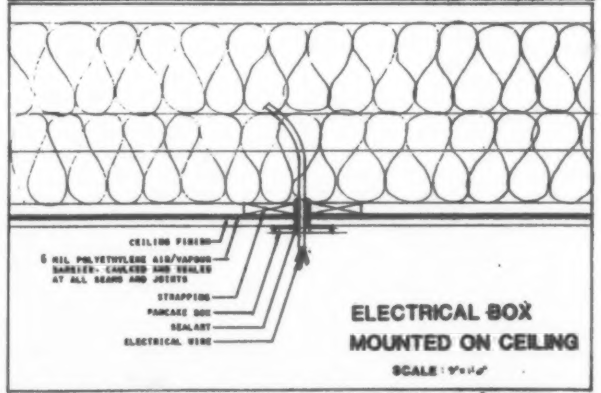
SCALE: 3"=1'-0"


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
MINIMUM 2" CLEARANCE
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY

CHIMNEY PENETRATION OF CEILING

SCALE : 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING

SCALE : 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG [illegible] TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

[illegible]

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CONSTRUCTION & ENGINEERING DETAILS

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13-77 [illegible]
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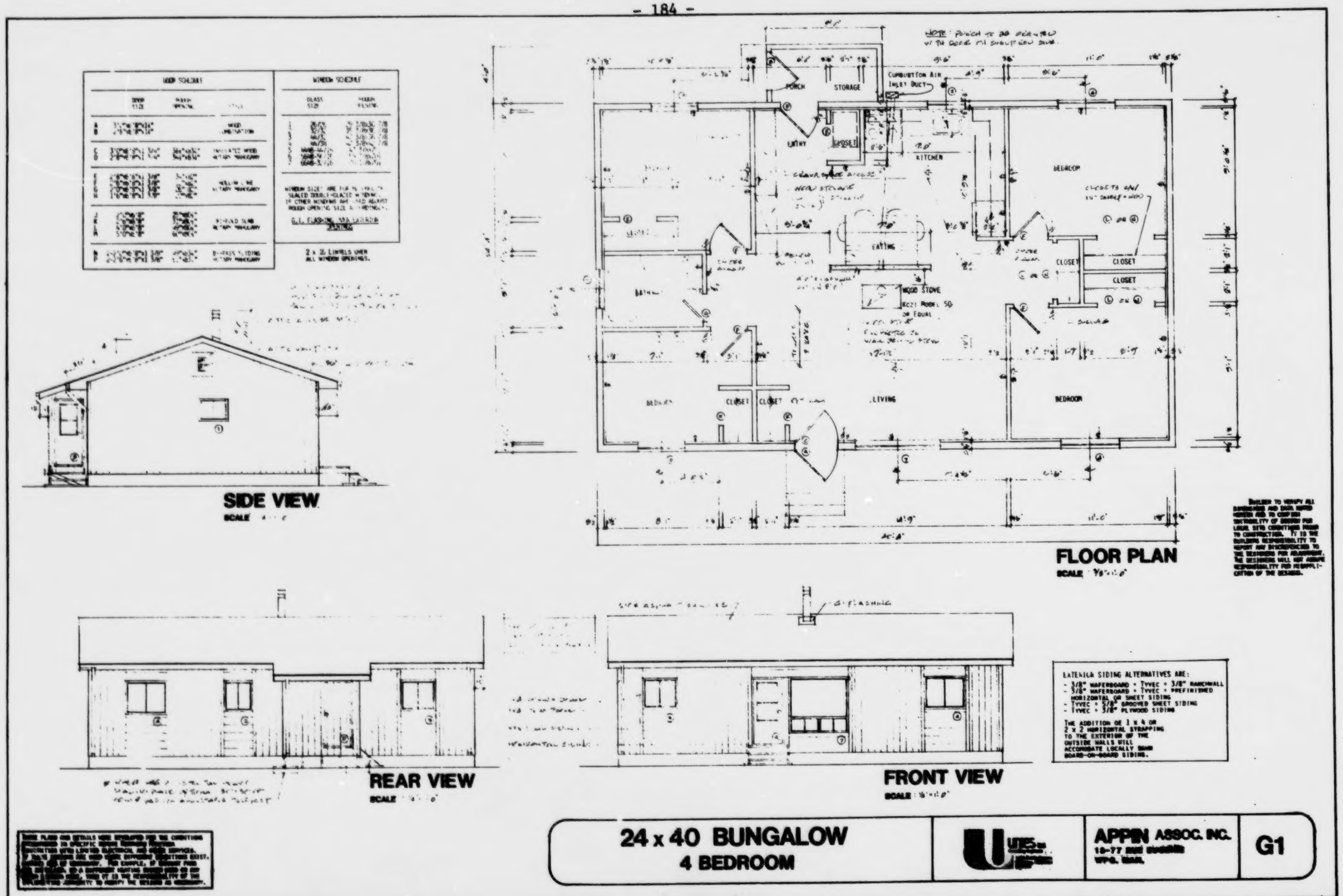
5

3.5 24' x 40' Bungalow (4 bedroom) Design Features

There is approximately 960 sq. ft. of floor area in this design.

- Another familiar layout, with an open central living area flanked on both sides by bedrooms.
- The exits/entries provided at both the living room side of the house and the kitchen side.
- The bathroom location is somewhat distant from both exits. However, access to the outside from the bathroom does not require travel through living, eating or kitchen area, only along side these spaces.
- A vestibule entry could be incorporated into the back entry of the house by extending the closet wall to the bedroom wall and installing another door.
- The wood stove is in a centralized location - providing a visual separation between the differing functions occuring within this central space.
- Due to the length of the house, heat distribution may be a problem if no ventilation system is used, especially if doors to the bedrooms are kept closed.
- The dining area allows for a built-in bench seat and table.
- Note that no storage or utility room has been provided.


DOOR SCHEDULE
WINDOW SCHEDULE
2 x 10 LINTELS OVER ALL WINDOW OPENINGS.
SIDE VIEW
SCALE
FLOOR PLAN
SCALE
PORCH
STORAGE
COMBUSTION AIR INLET DUCT
ENTRY
CLOSET
KITCHEN
BEDROOM
CLOSETS C/W 1/2" SHELF + ROD
EATING
WOOD STOVE
KOZI MODEL 50 OR EQUAL
CLOSET
CLOSET
CLOSET
BATH
BEDROOM
CLOSET
CLOSET
LIVING
BEDROOM
REAR VIEW
SCALE
FRONT VIEW
SCALE
G.I. FLASHING

EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" WAFERBOARD + TYVEC + 3/8" RANCHWALL
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

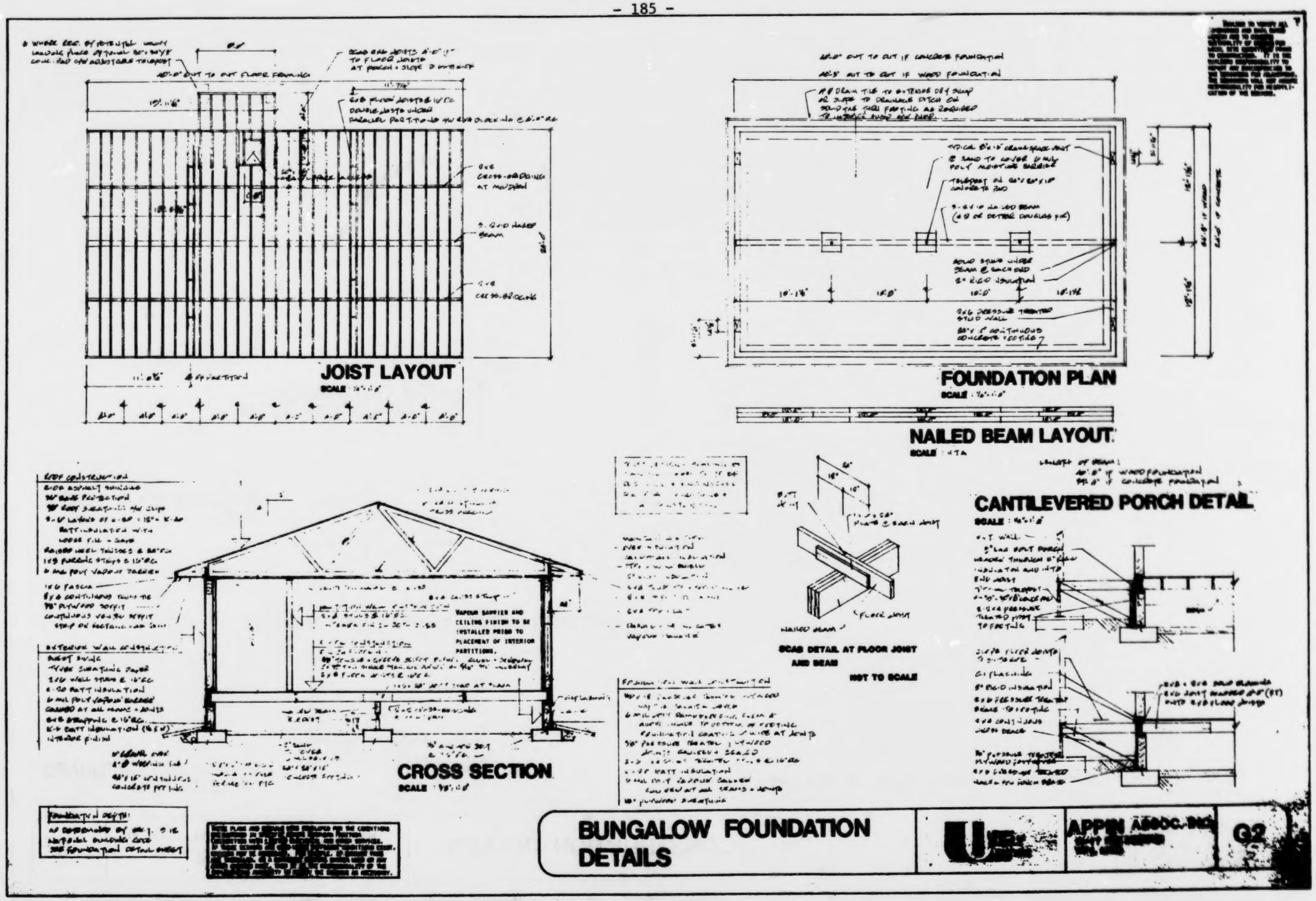
THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

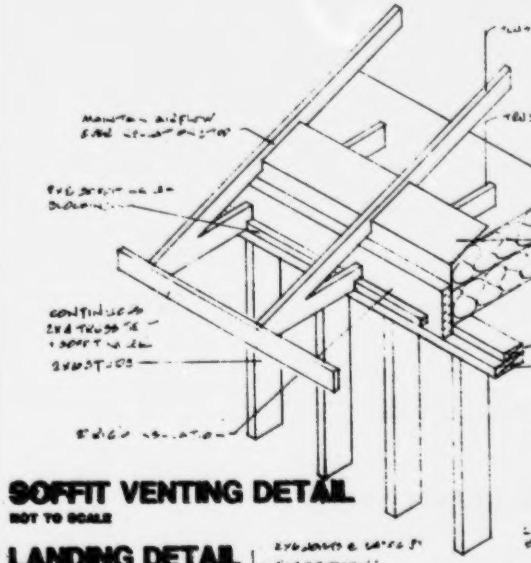
BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

24 x 40 BUNGALOW
4 BEDROOM

APPIN ASSOC. INC.

G1


JOIST LAYOUT
SCALE
40'-0" OUT TO OUT FLOOR FRAMING
2x8 FLOOR JOISTS @ 16" O.C.
DOUBLE JOISTS UNDER PARALLEL PARTITIONS
2x8 CROSS-BRIDGING AT MIDSPAN
3-2x10 NAILED BEAM
2x8 CROSS-BRIDGING
FOUNDATION PLAN
SCALE
40'-0" OUT TO OUT IF CONCRETE FOUNDATION
40'-5" OUT TO OUT IF WOOD FOUNDATION
TYPICAL 8"x16" CRAWLSPACE VENT
2x6 PRESSURE TREATED STUD WALL
2" RIGID INSULATION
NAILED BEAM LAYOUT
SCALE : NTS
LENGTH OF BEAM:
40'-0" IF WOOD FOUNDATION
CANTILEVERED PORCH DETAIL
SCALE
CROSS SECTION
SCALE
ROOF CONSTRUCTION
EXTERIOR WALL CONSTRUCTION
VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.
SCAB DETAIL AT FLOOR JOIST AND BEAM
NOT TO SCALE
NAILED BEAM
FLOOR JOIST
FOUNDATION DEPTH:
AS DETERMINED BY SEC. 9.12 NATIONAL BUILDING CODE
BUNGALOW FOUNDATION DETAILS
APPIN ASSOC. INC
G2

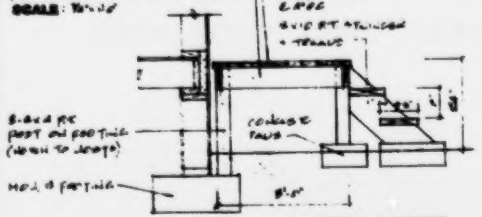

TRUSS TOP CHORD
TRUSS BOTTOM CHORD
CONTINUOUS
2x4 TRUSSES
2x6 TOP PLATE
2x6 PLATE

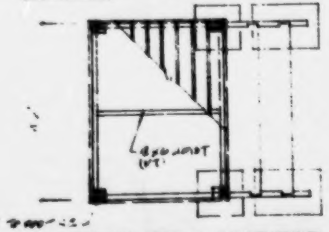
SOFFIT VENTING DETAIL

NOT TO SCALE

LANDING DETAIL

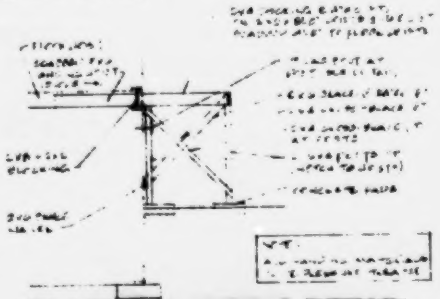
SCALE:


CONCRETE PADS



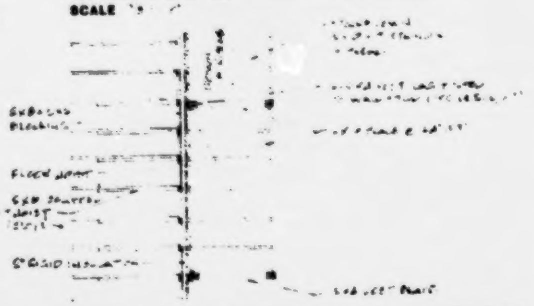
PLAN VIEW OF LANDING

SCALE:



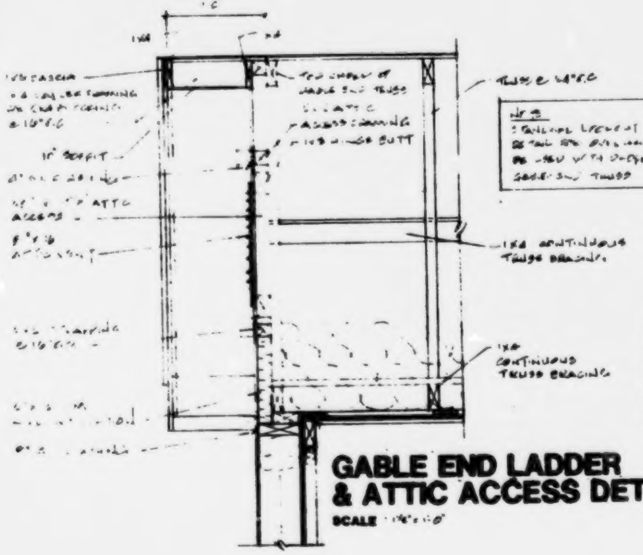
BI-LEVEL LANDING DETAIL

SCALE:



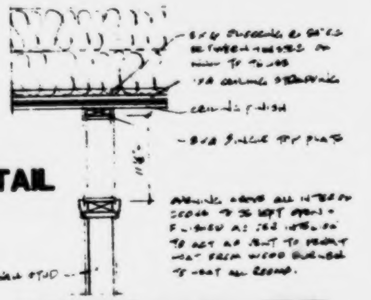
PLAN VIEW OF BI-LEVEL LANDING

SCALE:


16" SOFFIT
1x4 CONTINUOUS TRUSS BRACING
1x4 CONTINUOUS TRUSS BRACING

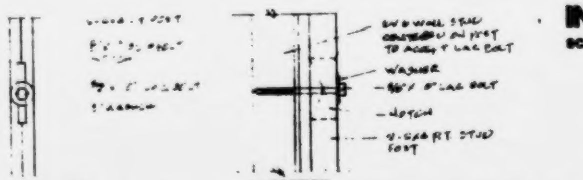
GABLE END LADDER & ATTIC ACCESS DETAIL

SCALE :


CEILING FINISH
WALL STUD

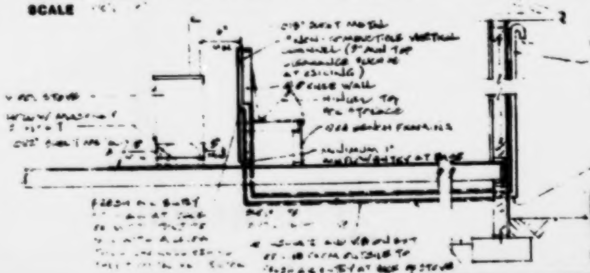
INTERIOR ROOM VENT

SCALE :


WASHER
NOTCH
FRONT VIEW
X-SECTION

LAG BOLT DETAIL AT BI-LEVEL LANDING

SCALE :



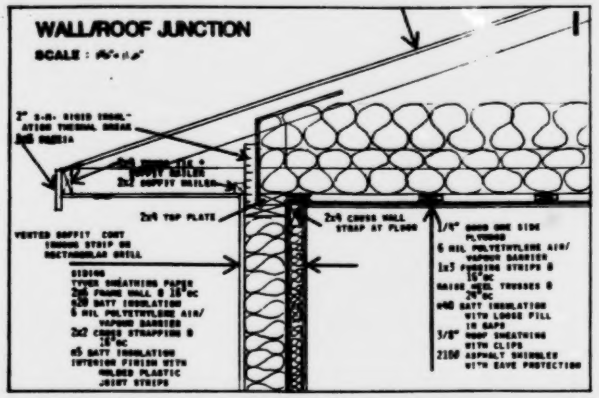
BENCH AND FIREGUARD WALL DETAIL

SCALE :

CONSTRUCTION DETAILS

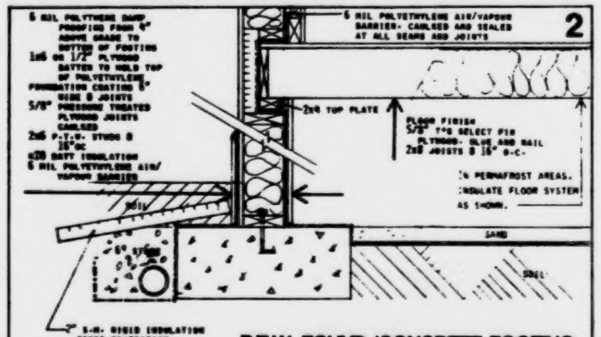
APPIN ASSOC. INC.

3


WALL/ROOF JUNCTION

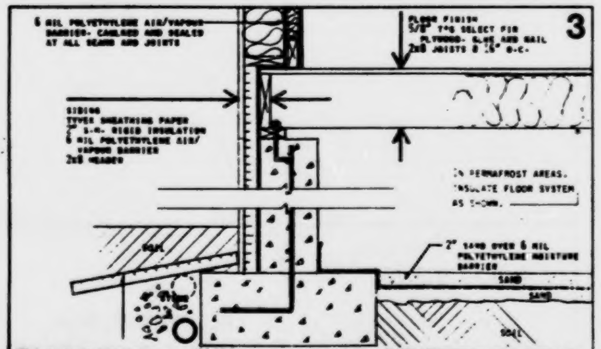
SCALE : [illegible]

1
2" S.R. RIGID INSULATION THERMAL BREAK
2x6 FASCIA
2x2 SOFFIT NAILER
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONT. SCREEN STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16"OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16"OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
1x3 FURRING STRIPS @ 16"OC
RAISED HEEL TRUSSES @ 24"OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION


P.T.W. FOUND./CONCRETE FOOTING

SCALE [illegible]

2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
SAND
6" STONE
2" S.R. RIGID INSULATION FROST PROTECTION 2' WIDE


CONCRETE FOUND. CONCRETE FOOTING

SCALE [illegible]

3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
SIDING
TYVEK SHEATHING PAPER
2" S.R. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SOIL
SAND
2" S.R. RIGID INSULATION FROST PROTECTION 2' WIDE

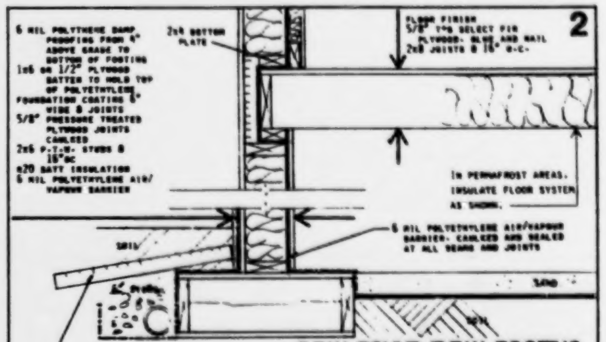
1 The use of raised heel trusses allows increased levels of insulation in the ceiling along the outside walls, reducing condensation problems in this area. The insulation retainer and wind break is made of cardboard. It is stapled between the rafters. It prevents wind from blowing through the insulation along the soffits and it holds the insulation away from the roof sheating, allowing air flow for attic ventilation. The 1 x 3 ceiling strapping retains the attic insulation during construction and provides a nailing strip for the ceiling finish.

2 This detail shows vapour barrier placement for the junction between the first floor and a preserved wood foundation. After the foundation wall has been constructed, a strip of 6 mil poly two feet wide is placed over the lower top plate. About 6 inches of the poly hangs down the inside of the wall. The remainder hangs down on the outside of the wall. The upper top plate is then installed, holding the poly in place during construction of the floor assembly. The poly strip on the outside of the rim joist or joist header is wrapped around the rim joist and over the floor prior to erection of the upper wall. The upper wall is placed on this poly strip. When the wall vapour barriers are installed, caulk them to the rim joist vapour barrier using acoustical sealant. Do not insulate the space inside the rim joist.

3 Frame wall overhangs joist header and concrete crawl space wall by 2". 6 mil poly vapour barrier runs under bottom plate of frame wall and on the crawl space wall, to the footing. 2" of rigid insulation is placed over the vapour barrier. Do not insulate inside of joist header. At footing, rigid insulation is extended horizontally 2 feet to provide a thermal break. Groundsheet in crawl space is required for moisture control. It is held in place and protected by a layer of sand or fine soil.

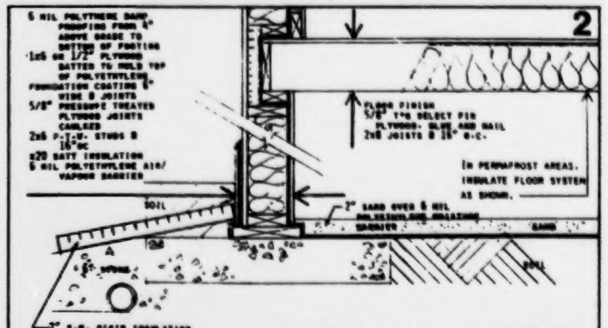
Unheated crawl space is only recommended where house is located on permafrost. The plywood floor sheating serves as the floor vapour barrier. Caulk the wall vapour barrier to the floor sheathing and caulk the seams between the sheets of plywood. A 6 mil poly groundsheet is located under the house and protected with a layer of sand.

The minimum depth of foundations sited on clays or soils not clearly defined shall be 4 feet unless experience with local soil conditions show that lesser depths are satisfactory. (Section 9.12 National Building Code).


P.T.W. FOUND./P.T.W. FOOTING

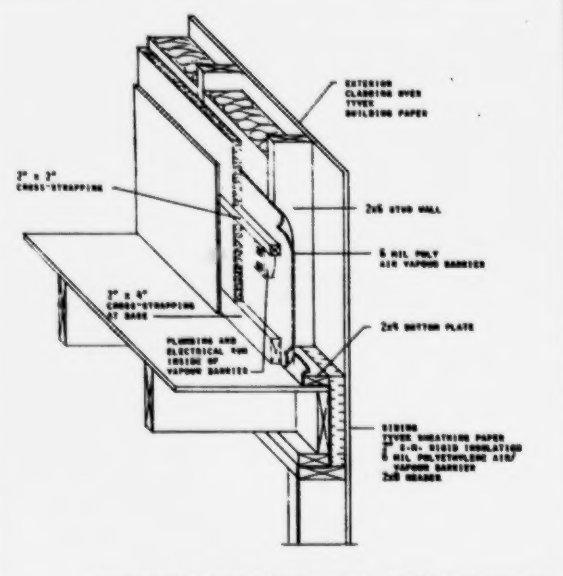
SCALE : [illegible]

2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 BOTTOM PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SOIL
SAND
2" S.R. RIGID INSULATION FROST PROTECTION 2' WIDE


P.T.W. FOUND./2x10 P.T.W. FOOTING

SCALE : [illegible]

2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16"OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SOIL
SAND
6" STONE
2" S.R. RIGID INSULATION FROST PROTECTION 2' WIDE

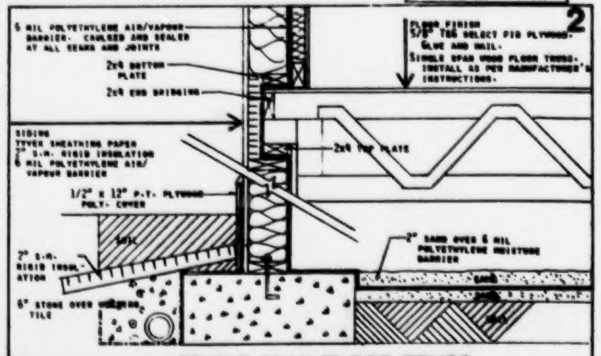

WALL/FLOOR JOIST HEADER - CUTAWAY DETAIL

NOT TO SCALE

EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
2x4 BOTTOM PLATE
SIDING
TYVEK SHEATHING PAPER
2" S.R. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER

NOTE ALL FLOOR CONST. CHANGED TO:

FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD OR 5/8" T&G STD. SPRUCE PLY. C/W 5/16" STD. PLY. UNDERLAY. GLUE & NAIL
2x8 JOISTS @ 16" O.C.


SINGLE SPAN FLOOR TRUSS

SCALE : [illegible]

2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS. INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
SIDING
TYVEK SHEATHING PAPER
2" S.R. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P.T. PLYWOOD POLY. COVER
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
2" S.R. RIGID INSULATION
6" STONE OVER WEEPING TILE
SOIL
SAND

[illegible]

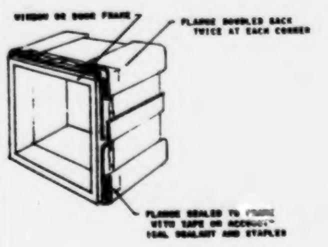
Builder to verify all dimensions and data noted herein and to confirm suitability of design for local site conditions prior to construction. It is the builders responsibility to report any discrepancies to the designers for adjustment. The designers will not assume responsibility for misapplication of the designs.

CONSTRUCTION & ENGINEERING DETAILS

UTES

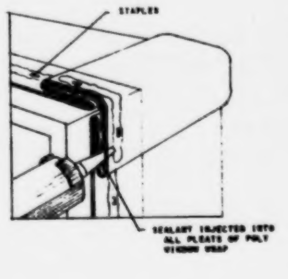
APPIN ASSOC. INC.
13-77 RUE EUGENIE
WPG. MAN.

4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

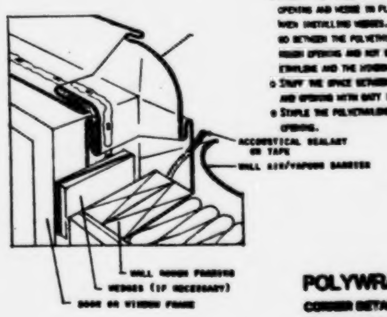
- CUT A 20 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 36 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO ONE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

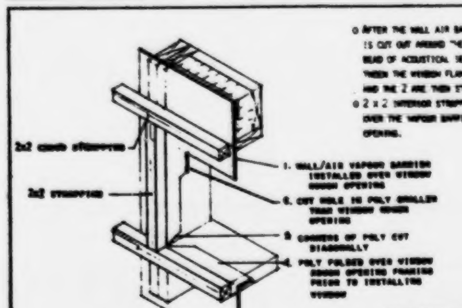
- LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2


ACCOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

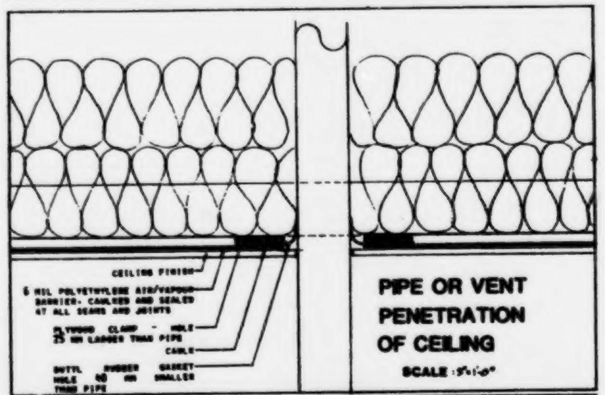
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3

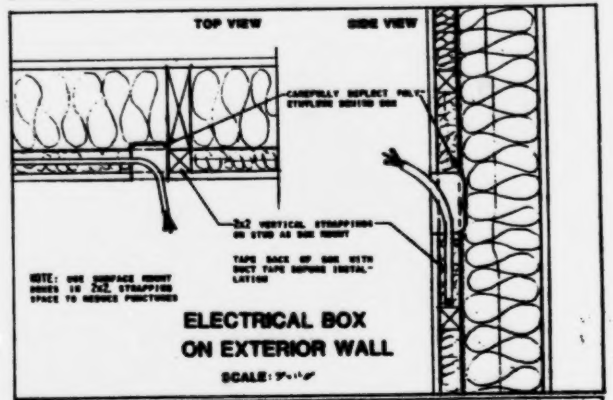

2x2 CROSS STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 x 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4

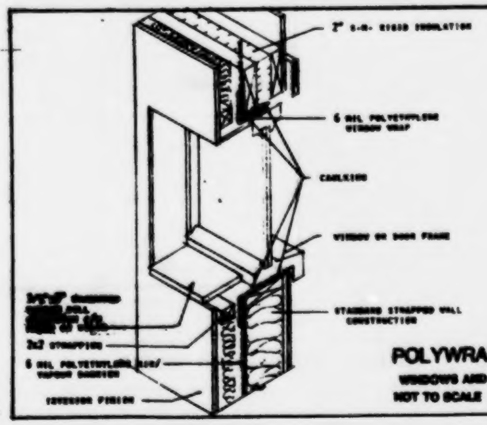

CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CABLE
BUTYL RUBBER GASKET HOLE 40 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE : 3"=1'-0"

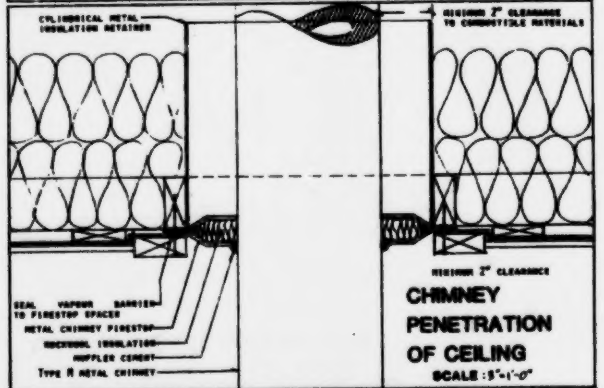

TOP VIEW
SIDE VIEW
CAREFULLY REFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPING ON STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION

NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE: 3"=1'-0"

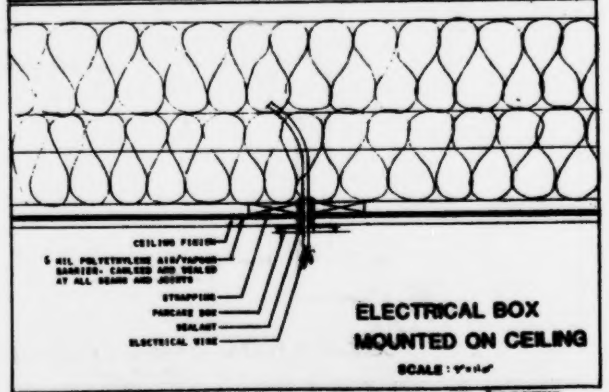

2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
3/4"x2" HARDWOOD
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE
5


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY
MINIMUM 2" CLEARANCE

CHIMNEY PENETRATION OF CEILING
SCALE : 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE : 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

[illegible]

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNER FOR ADJUSTMENT. THE DESIGNER WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGN.

CONSTRUCTION & ENGINEERING DETAILS

UNIES ltd

APPIN ASSOC. INC.
10-77 [illegible]
WPG. MAN.

5

IV. BI-LEVEL DESIGNS

Initially, there was a less than positive reaction to house forms other than the bungalow. The Design Team found that when the Bilevel designs were presented to the communities, the response was positive (see Appendices I and II).

The bi-level plan is a very efficient plan as it is the most cost effective to construct. Figure 4.1 shows the innovative heat distribution system developed by the Design Team.

The bi-level plans developed are as follows:

1. 18' x 26' Plan "A" (3 br)
2. 18' x 26' Plan "B" (4 br)
3. 24' x 32' (6 br maximum)

The plans and elevations of each of the designs is shown in turn. The complete set of drawings for the 18' x 26' Plan "A" house is shown for illustrative purposes. For more detailed information, readers are referred to the construction drawings under separate cover.

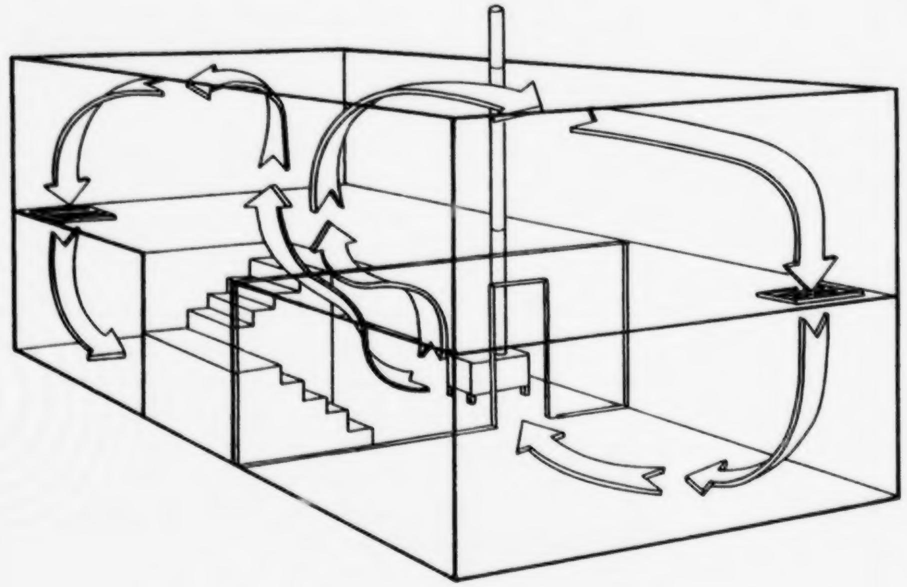


Figure 4.1
Heat Distribution System Used for the
Bi-level and 2 Storey Designs

4.1 Engineering Design Considerations and Solutions for the Bi-level Designs

Component	Problem	Proposed Solution
Foundation	Variations in soil conditions, house styles and materials costs between communities make it impossible to identify a single "best" foundation design for northern housing. Settling and heaving of foundations in some communities causes structural damage to the houses. High humidity in crawl spaces causes deterioration of floor system.	A variety of foundation designs were prepared, making it possible for the builder to choose the most economical foundation for each project. Any of the house designs can be built using clear span, prefabricated floor trusses. All plans specify 6 mil poly ground sheets under crawl spaces to control ground source moisture problems.
Floor System	Floor tiles, especially at entrances, lift off.	Use of sheet flooring is recommended.
Exterior Walls	The climate in the north dictates that the house exterior walls have high insulation levels and be of airtight construction. Finishes must be sturdy. Construction must be simple and straightforward, reflecting the manpower, equipment and financial constraints common to native housing projects.	All exterior walls are 2 x 6 frame construction, cross strapped with 2 x 2's on the interior. The vapour barrier is located between the 2 x 6 and 2 x 2 framing. The entire wall cavity is filled with with insulation, yielding R-25 walls with only minimal amounts of thermal bridging. Wiring in outside walls is located completely inside the vapour barrier reducing the number of perforations in the vapour barrier. Heavier exterior cladding than those currently used are recommended. Wall construction is simple, and not much diffierent than is currently being built in the native communities.
Windows	Windows are a major source of heat loss in northern housing. This is due to air leakage around the window frame and within the window unit.	Non operating windows are specified wherever possible. The size of operating windows is minimized. "Lexan" plastic windows are not recommended because they may prevent windows from serving as an exit in event of a fire.
Exterior Doors	Snow hinging and cold weather failure of weatherstripping are common problems.	It is recommended that insulated steel exterior doors be used. Doors to be double weatherstripped. Use four 4-screw door hinges with 3" long screws which screw through into the framing around the rough opening. An attached porch detail is included with most house plans. Porches reduce snow accumulation on door jambs and threshholds.

Component	Problem	Proposed Solution
	Doors are hard to open when wearing mitts.	Lever type openers with D-ring handles are recommended.
Ceilings and Roofs	Moisture accumulation in attics is a major cause of ceiling damage.	Specifications call for a continuous 6 mil poly vapour barrier sealed at all seams and penetrations in the ceiling. The vapour barrier and ceiling finish are to be installed prior to placement of interior partitions. Raised heel trusses are specified. An insulation retainer and wind shield minimizies the amount of snow blowing in the soffits and into the insulation. It also helps keep outside ceiling corners warm, reducing condensation problems. The designs minimize the number of ceiling mounted electrical fixtures, thus the number of penetrations in the ceiling vapour barrier.
Heating and Ventilation	Fire safety is a significant concern wherever wood heating is used.	Well constructed, airtight wood stoves with brick liners are specified. All stoves to be mounted on non combustible surfaces and adjacent walls are protected by metal shielding conforming to CSA Can 3-B365-M84. Where closer clearances to walls are required, shielded stoves are specified. Type M, high temperature chimneys are specified.
	An outside air supply is required for combustion appliances in energy efficient houses. Ventilation air is required to control indoor humidity. Mechanical ventilation is impractical in housing equipped with 15 amp service. Cold ventilation air must not reduce occupant comfort, or attempts may be made to block the fresh air inlet. This could cause stove backdrafting, and create a health hazard due to smoke or carbon monoxide build-up in the house.	An outside air supply duct has been designed to introduce fresh air through the wall behind the heat shielding near the stove. The fresh air will be warmed by the shield, and will mix with house air, providing ventilation for occupant comfort. This fresh air inlet location greatly reduces the likelihood of the occupant blocking off the inlet. The stove draws combustion air from the space around it, thus removing stale air and humidity from the house.
	Moving heat from the stove to the far reaches of the house is difficult without the use of fans and ductwork.	To facilitate air movement throughout the house, the stove is located in the lower level, near the stairwell. The stairwell is open allowing heat to rise to the second floor. Grilles located in each corner, allow this air to flow back down to the lower level as it cools along the outside walls. The open stairwell and floor grilles allow the air to circulate throughout the house. The stove on the lower level reheats the cool return air and it again rises into the upper level. High wall grilles allow warm air to circulate into closed rooms. Undercutting doors allows cool air to flow out of rooms.

Component	Problem	Proposed Solution
	If indoor plumbing services or trucked water systems are introduced to the community, conversion of existing housing stock to benefit from these systems is difficult.	Many of the house designs have areas that are well suited for locating water storage tanks. Where practical, washrooms and kitchens are located back to back, to facilitate joint plumbing. The Background Review Report identified a design in which a mechanical seal toilet in an upper level washroom can flush to a waste bucket located outside the house.
Electrical Systems	Wiring in conventional housing results in numerous perforations in the poly vapour barrier.	All wiring is to be done from the crawl space (unless the floor system is insulated and the crawl space is unheated) thus reducing penetrations through the ceiling vapour barrier. As much as possible wiring should be done on interior paritions. The vapour barrier on outside walls is set back sufficiently into the wall to allow all wiring to be run inside the vapour barrier.

4.2 18' x 26' Bi-level Plans

There is approximately 936 sq. ft. of useable floor area in these plans.

4.2.1 Plan "A" (4 bedroom) Design Features

- Four bedrooms are possible. A 3 bedroom version with a utility/storage room on main floor could be built as an option.

- Bi-level plans are an economical use of space as in most cases a crawlspace is constructed which is otherwise a wasted area of limited use (865 sq. ft.).

- There is an equivalent material cost to that of a 24' x 36' bungalow with similar finishes.

- The bathroom, located on the lower level, is easily accessible to the house exit for those families which use the "honey bucket" system (i.e. the path from the bathroom to the exit does not infringe upon the main living areas of the house).

- The wood stove is centrally located on the lower level, allowing for adequate heat flow throughout the house (up through open staircase and down through (optional) air chutes located in the corners of the house.

- The main disadvantage with the wood stove location is unaccessibility for cooking. A smaller, secondary unit located on the upper main floor would solve this problem.

- A room for wood storage is located near the wood stove. A pass-through directly from the exterior into the room has been provided to allow easy transfer of wood without requiring carrying the wood through the living quarters.

- Separation between public and private spaces within the house has been obtained without sacrificing a lot of valuable floor area.

- There is a good means of egress in case of fire. An option available to homeowners in the construction of an exterior stairway from the main floor to grade level, which will allow one to exit directly from the living room. A deck could also be incorporated into this scheme.

- No vestible entrance has been provided, but one could easily be included when funds are available by framing and sheathing in the main entrance landing.

- The 18 foot width of the house allows for the optional use of clear span floor joists when required, thus simplifying construction techniques and eliminating the need for a central beam. This helps to reduce problems created with foundation heaving and settling.

- The open plan style on main level provides feeling of spaciousness while still allowing a distinction to be made between the various activity areas.

4.2.2 Plan "B" (4 bedroom) Design Features

- Four bedrooms are possible on the lower level of the bi-level.

- A utility/storage room is located on the upper level, adjacent to the stairway.

- Bi-level plans are an economical use of space as in most cases a crawlspace is constructed which is otherwise a wasted area of limited use (865 sq. ft.).

- There is equivalent material cost to that of a 24' x 36' bungalow with similar finishes.

- The bathroom, located on the upper level, is easily accessible to the house exit for those families which use the "honey bucket" system (i.e. the path from the bathroom to the exit does not infringe upon the main living areas of the house).

- The wood stove is centrally located on the lower level, allowing for adequate heat flow throughout the house (up through open staircase and down through (optional) air chutes located in the corners of the house.

- The main disadvantage with the wood stove location is unaccessibility for cooking. A smaller, secondary unit located on the upper main floor would solve this problem.

- A room for wood storage is located near the wood stove. A pass-through directly from the exterior into the room has been provided to allow easy transfer of wood without requiring carrying the wood through the living quarters.

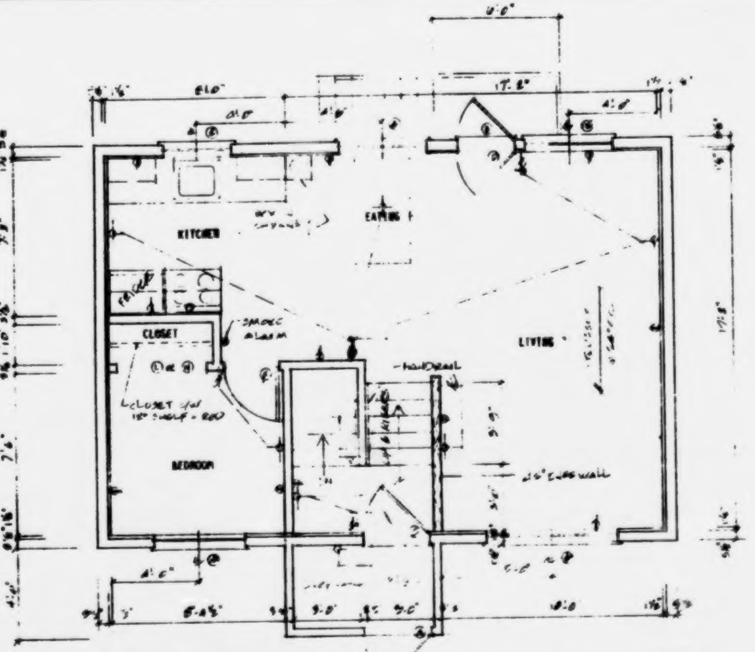
- Separation between public and private spaces within the house has been obtained without sacrificing a lot of valuable floor area.

- There is a good means of egress in case of fire. An option available to homeowners in the construction of an exterior stairway from the main floor to grade level, which will allow one to exit directly from the living room. A deck could also be incorporated into this scheme.

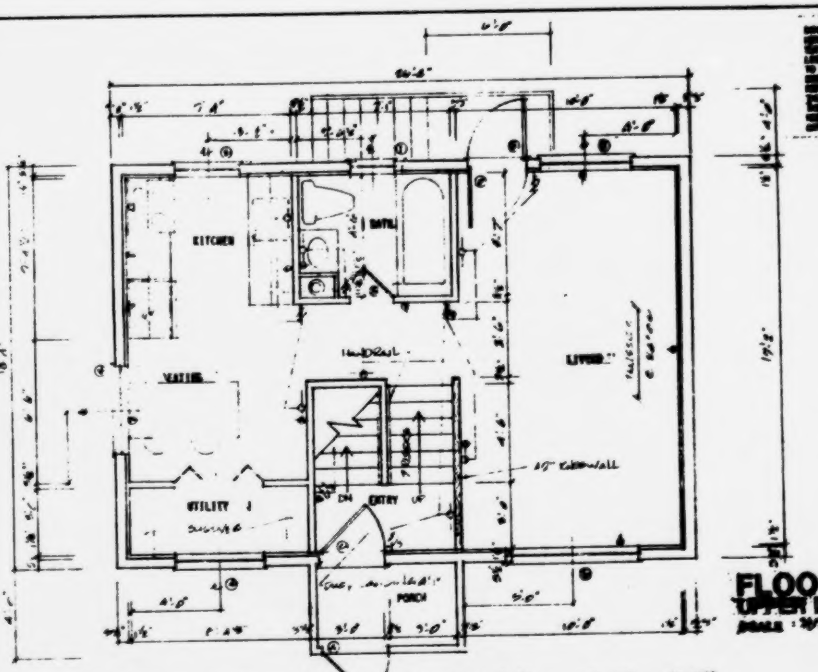
- No vestible entrance has been provided, but one could easily be included when funds are available by framing and sheathing in the main entrance landing.

- The 18 foot width of the house allows for the optional use of clear span floor joists when required, thus simplifying construction techniques and eliminating the need for a central beam. This helps to reduce problems created with foundation heaving and settling.

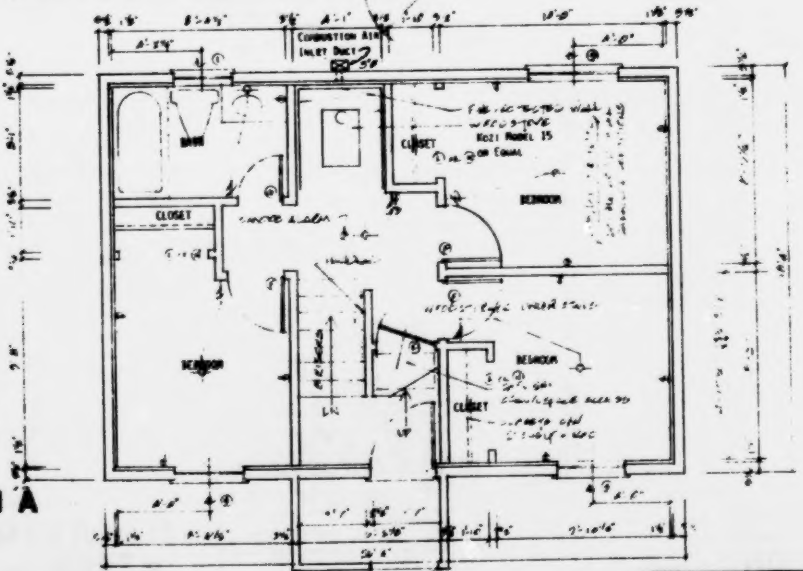
- The open plan style on main level provides feeling of spaciousness while still allowing a distinction to be made between the various activity areas.


KITCHEN
EATING
LIVING
CLOSET
BEDROOM
HANDRAIL

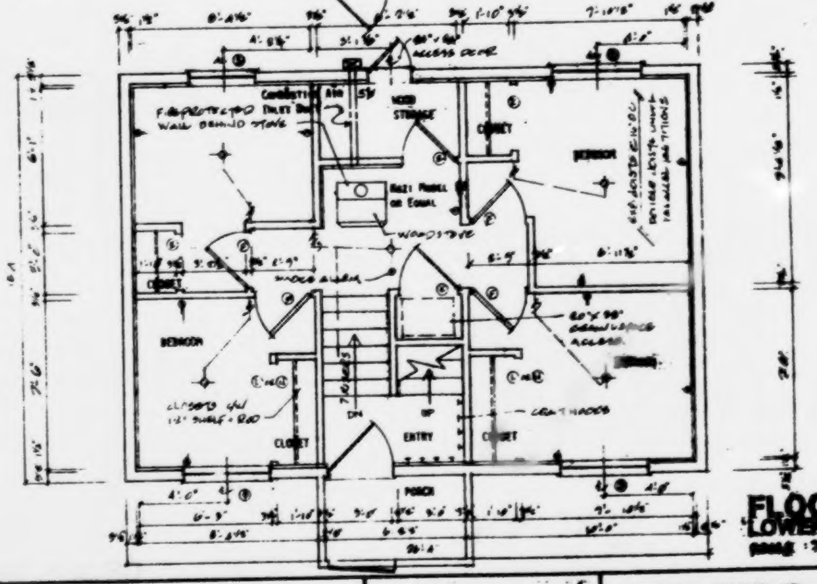
FLOOR PLAN
UPPER LEVEL
SCALE : 1/8"=1'-0"


KITCHEN
BATH
LIVING
EATING
UTILITY
ENTRY
PORCH
HANDRAIL

FLOOR PLAN
UPPER LEVEL
SCALE : 1/8"=1'-0"


COMBUSTION AIR INLET DUCT
BATH
CLOSET
BEDROOM
KOZI MODEL 15 OR EQUAL
CLOSET

FLOOR PLAN A
LOWER LEVEL
SCALE : 1/8"=1'-0"


COMBUSTION AIR
WOOD STORAGE
CLOSET
BEDROOM
KOZI MODEL OR EQUAL
WOODSTOVE
ENTRY
PORCH
CLOSET

FLOOR PLAN B
LOWER LEVEL
SCALE : 1/8"=1'-0"

18 x 26 BI-LEVEL
4 BEDROOMS

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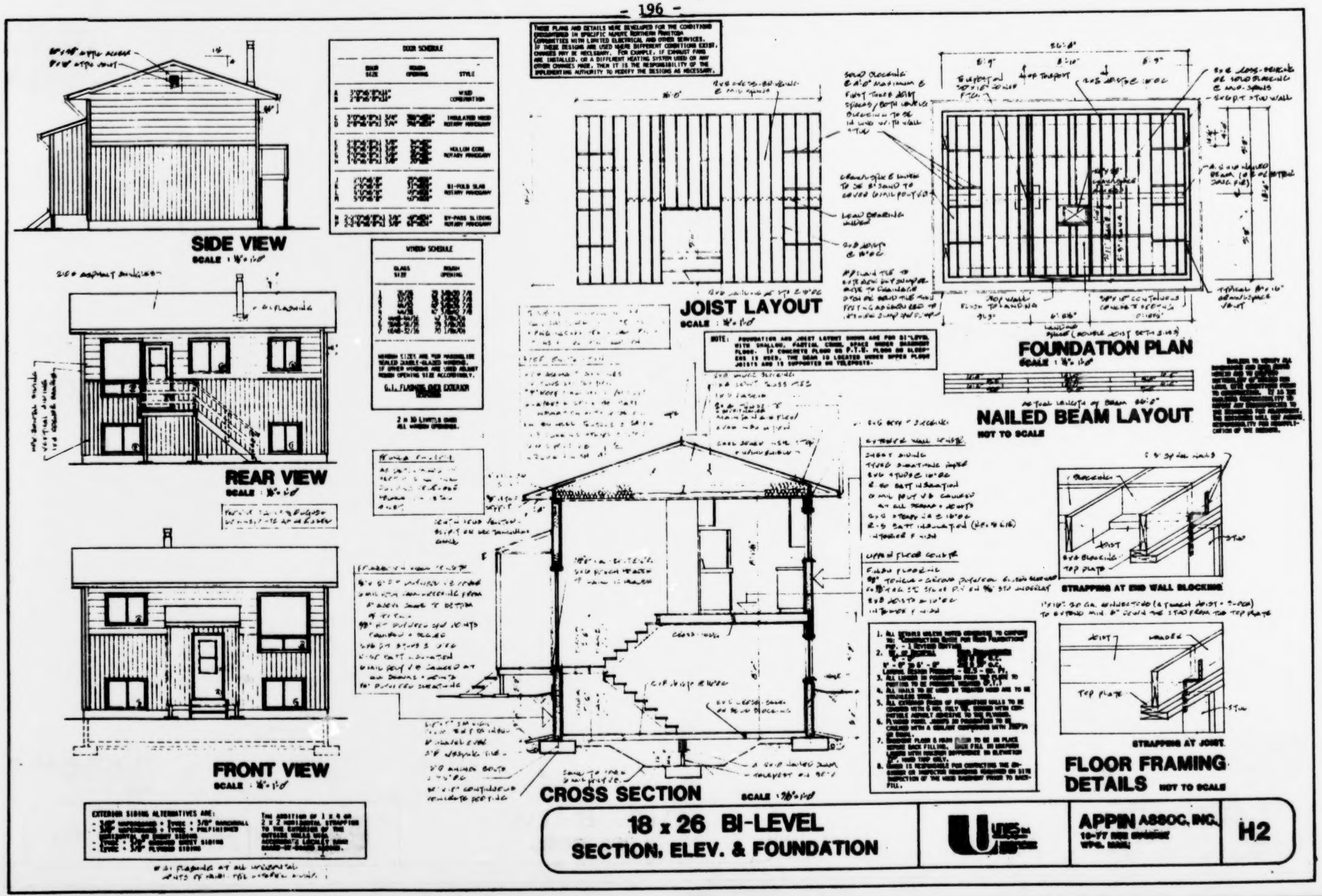
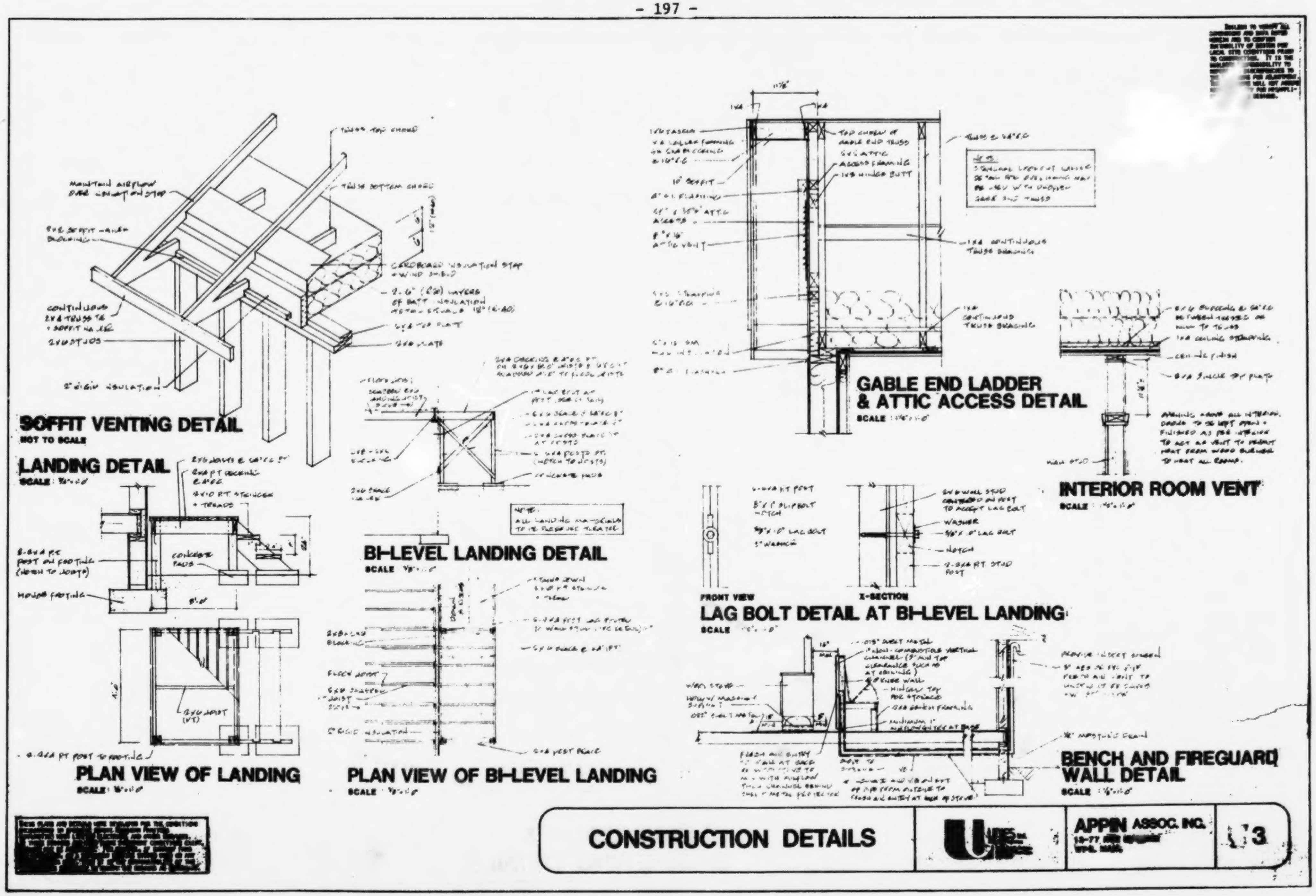
H1

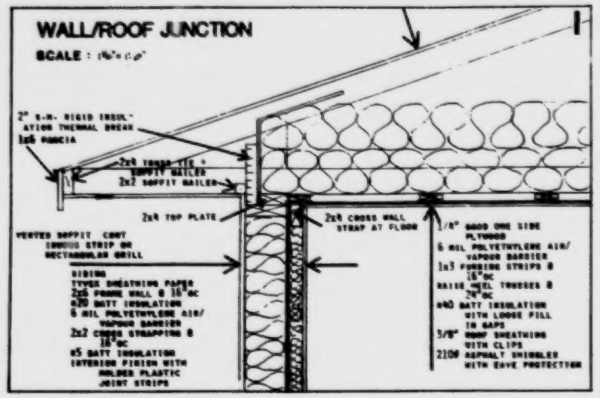

SIDE VIEW
SCALE : ¼" = 1'-0"
REAR VIEW
SCALE : ¼" = 1'-0"
FRONT VIEW
SCALE : ¼" = 1'-0"
DOOR SCHEDULE
WINDOW SCHEDULE
JOIST LAYOUT
SCALE : ¼" = 1'-0"
FOUNDATION PLAN
SCALE : ¼" = 1'-0"
NAILED BEAM LAYOUT
NOT TO SCALE
CROSS SECTION
SCALE : ⅜" = 1'-0"
STRAPPING AT END WALL BLOCKING
STRAPPING AT JOIST
FLOOR FRAMING DETAILS NOT TO SCALE
16'-0"
26'-0"
JOIST
TOP PLATE
STUD
18 x 26 BI-LEVEL
SECTION, ELEV. & FOUNDATION
APPIN ASSOC. INC.
H2

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS ENCOUNTERED IN SPECIFIC REMOTE NORTHERN MANITOBA COMMUNITIES WITH LIMITED ELECTRICAL AND OTHER SERVICES. IF THESE DESIGNS ARE USED WHERE DIFFERENT CONDITIONS EXIST, CHANGES MAY BE NECESSARY. FOR EXAMPLE, IF EXHAUST FANS ARE INSTALLED, OR A DIFFERENT HEATING SYSTEM USED OR ANY OTHER CHANGES MADE, THEN IT IS THE RESPONSIBILITY OF THE IMPLEMENTING AUTHORITY TO MODIFY THE DESIGNS AS NECESSARY.

NOTE: FOUNDATION AND JOIST LAYOUT SHOWN ARE FOR BI-LEVEL WITH SHALLOW, PARTIAL CRAWL SPACE UNDER BASEMENT FLOOR. IF CONCRETE FLOOR OR P.T.W. FLOOR ON SLEEPERS IS USED, THE BEAM IS LOCATED UNDER UPPER FLOOR JOISTS AND IS SUPPORTED ON TELEPOSTS.

1. ALL DETAILS UNLESS NOTED OTHERWISE TO CONFORM TO: "CONSTRUCTION GUIDE FOR WOOD FOUNDATIONS" [illegible]
2. [illegible]
3. ALL LUMBER IN FOUNDATION [illegible] TO BE PRESSURE TREATED P.T.W.
4. ALL NAILS TO BE USED IN TREATED WOOD ARE TO BE STAINLESS STEEL.
5. ALL EXTERIOR FACES OF FOUNDATION WALLS TO BE COVERED WITH 6 MIL. POLY [illegible] WITH COMPATIBLE ASPHALT ADHESIVE TO THE PLYWOOD.
6. PLYWOOD PANEL JOINTS IN FOUNDATION TO BE CAULKED WITH A SEALANT COMPOUND [illegible]
7. BASEMENT FLOOR & MAIN FLOOR TO BE IN PLACE BEFORE BACK FILLING. BACK FILL IN UNIFORM LAYERS WITH MAXIMUM DIFFERENCE IN ELEVATION [illegible] HAND TAMP ONLY.
8. [illegible] IS RESPONSIBLE FOR CONTACTING THE ENGINEER OR INSPECTOR [illegible] INSPECTION OF THE WOOD BASEMENT PRIOR TO BACKFILL.


SOFFIT VENTING DETAIL
NOT TO SCALE
MAINTAIN AIRFLOW OVER INSULATION STOP
TRUSS TOP CHORD
TRUSS BOTTOM CHORD
CARDBOARD INSULATION STOP + WIND SHIELD
2-6" (R-38) LAYERS OF BATT INSULATION
CONTINUOUS 2x4 TRUSS TIE + SOFFIT NAILER
2x6 STUDS
2" RIGID INSULATION
LANDING DETAIL
SCALE
CONCRETE PADS
HOUSE FOOTING
BI-LEVEL LANDING DETAIL
SCALE
NOTE: ALL LANDING MATERIALS TO BE PRESSURE TREATED
CONCRETE PADS
PLAN VIEW OF LANDING
SCALE
PLAN VIEW OF BI-LEVEL LANDING
SCALE
GABLE END LADDER & ATTIC ACCESS DETAIL
SCALE
1x4 CONTINUOUS TRUSS BRACING
INTERIOR ROOM VENT
SCALE
FRONT VIEW
X-SECTION
LAG BOLT DETAIL AT BI-LEVEL LANDING
SCALE
WASHER
NOTCH
BENCH AND FIREGUARD WALL DETAIL
SCALE
CONSTRUCTION DETAILS
APPIN ASSOC. INC.
3


1
2" S.M. RIGID INSULATION THERMAL BREAK
1x6 FASCIA
2x4 TRUSS TIE + SOFFIT NAILER
2x2 SOFFIT NAILER
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONT. [illegible] STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16"OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16"OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
1x3 FURRING STRIPS @ 16"OC
RAISE HEEL TRUSSES @ 24"OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION

WALL/ROOF JUNCTION

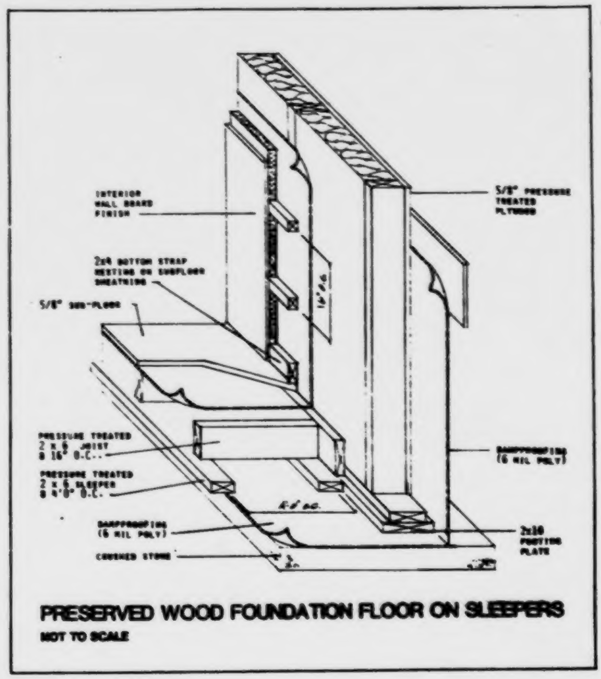
SCALE : 1½" = 1'-0"

1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 X 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR THE JUNCTION BETWEEN THE FIRST FLOOR AND A PRESERVED WOOD FOUNDATION. AFTER THE FOUNDATION WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL, THE REMAINDER HANGS DOWN ON THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL IS PLACED ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

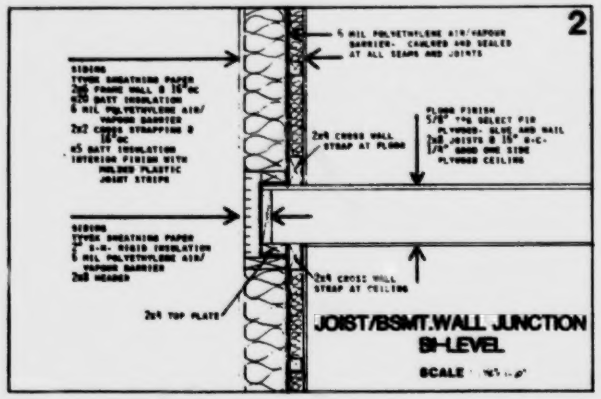
3 THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. PASS ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.


INTERIOR WALL BOARD FINISH
2x4 BOTTOM STRAP RESTING ON SUBFLOOR SHEATHING
5/8" SUB-FLOOR
16" O.C.
5/8" PRESSURE TREATED PLYWOOD
PRESSURE TREATED 2 x 6 JOIST @ 16" O.C.
PRESSURE TREATED 2 x 6 SLEEPER @ 4'0" O.C.
4'-0" O.C.
DAMPPROOFING (6 MIL POLY)
DAMPPROOFING (6 MIL POLY)
CRUSHED STONE
2x10 FOOTING PLATE

PRESERVED WOOD FOUNDATION FLOOR ON SLEEPERS

NOT TO SCALE

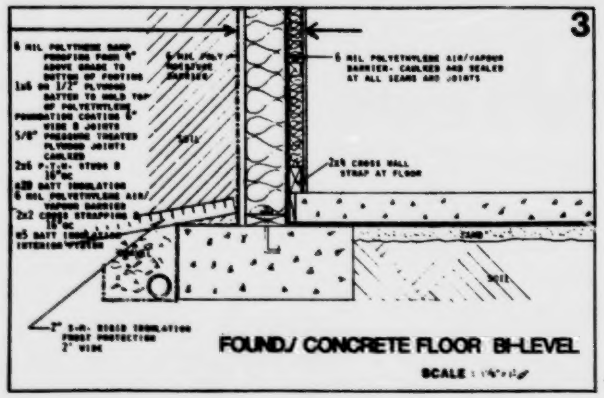

2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16"OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16"OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
1/4" GOOD ONE SIDE PLYWOOD CEILING
2x4 CROSS WALL STRAP AT FLOOR
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
2x4 CROSS WALL STRAP AT CEILING
2x4 TOP PLATE

JOIST/BSMT.WALL JUNCTION BI-LEVEL

SCALE : 1½" = 1'-0"

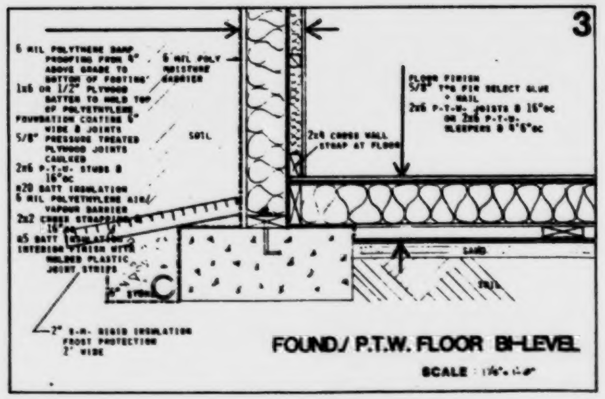
NOTE: ALL FLOOR JOIST CHANGED TO

FLOOR FINISH
5/8" T+G SELECT FIR
PLYWOOD OR 5/8"
T+G STD. SPRUCE PLY.
C/W 5/16" STD. PLY.
UNDERLAY. GLUE + NAIL
2x8 JOISTS @ 16" O.C.


3
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
6 MIL POLY MOISTURE BARRIER
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
SOIL
2x6 P.T.W. STUDS @ 16"OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16"OC
R5 BATT INSULATION
INTERIOR FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 CROSS WALL STRAP AT FLOOR
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE

FOUND./ CONCRETE FLOOR BI-LEVEL

SCALE : 1½" = 1'-0"


3
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
6 MIL POLY MOISTURE BARRIER
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
SOIL
2x6 P.T.W. STUDS @ 16"OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16"OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
FLOOR FINISH
5/8" T+G FIR SELECT GLUE + NAIL
2x6 P.T.W. JOISTS @ 16"OC OR 2x6 P.T.W. SLEEPERS @ 4'0"OC
2x4 CROSS WALL STRAP AT FLOOR
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE

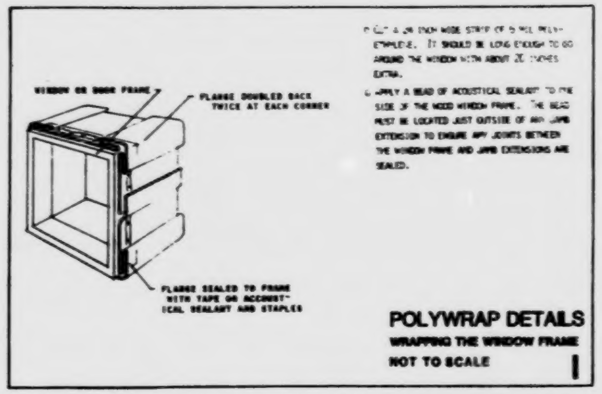
FOUND./ P.T.W. FLOOR BI-LEVEL

SCALE : 1½" = 1'-0"

[illegible] DETAILS WERE DEVELOPED FOR THE CONDITIONS [illegible] SPECIFIC [illegible] [illegible] LIMITED ELECTRICAL AND OTHER SERVICES. [illegible] WHERE DIFFERENT CONDITIONS EXIST. [illegible] [illegible] [illegible] IT IS THE RESPONSIBILITY OF THE [illegible] TO VERIFY THE DESIGN AS NECESSARY.

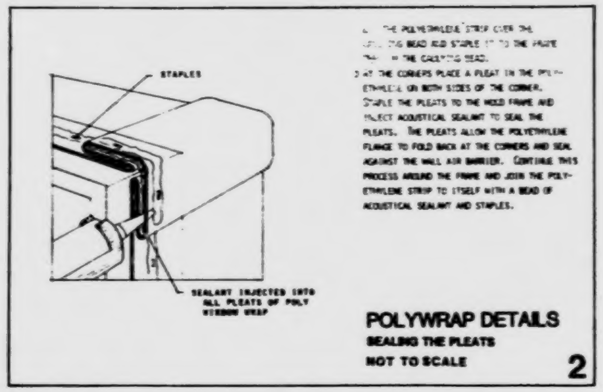
BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS	UNIES Ltd	**APPIN** ASSOC. INC. 13-77 RUE [illegible] WPG. MAN.	14


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

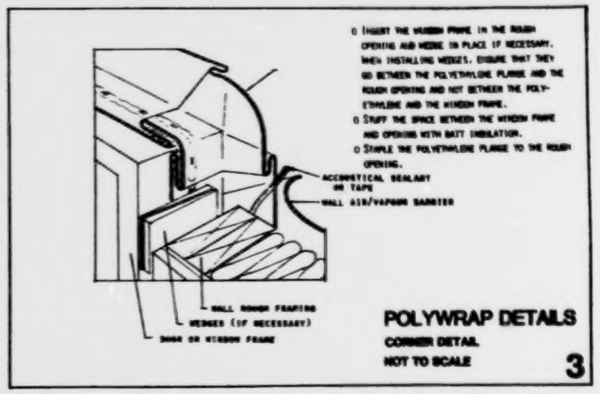
- CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO THE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

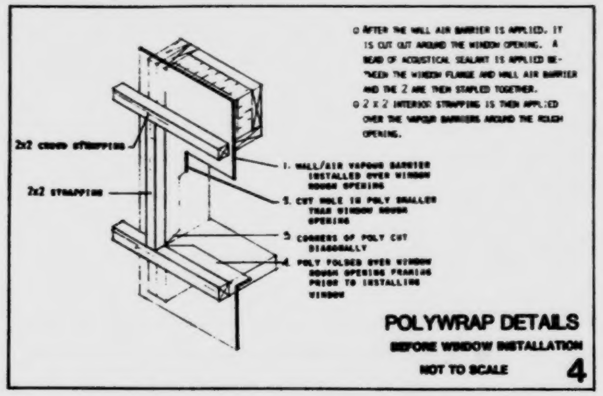
- LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2


ACCOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

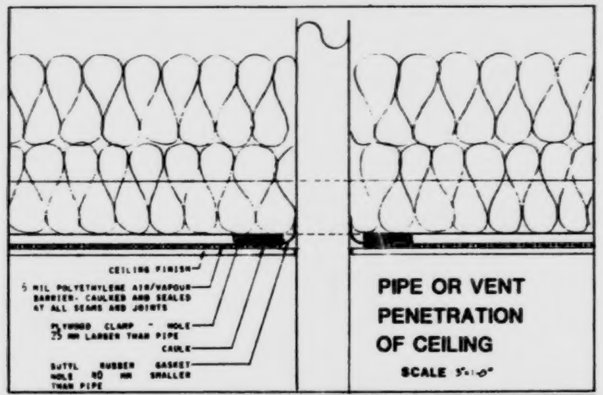
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3

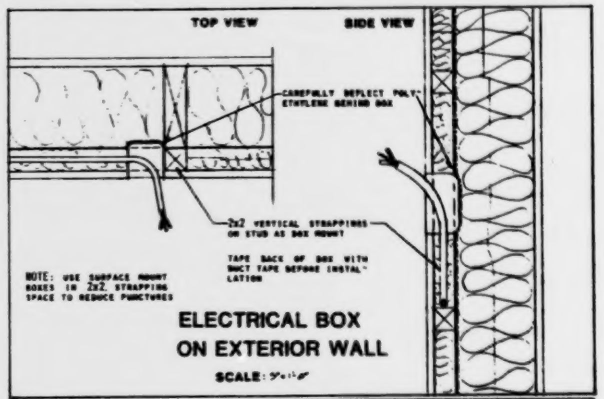

2x2 CROSS STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 X 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4

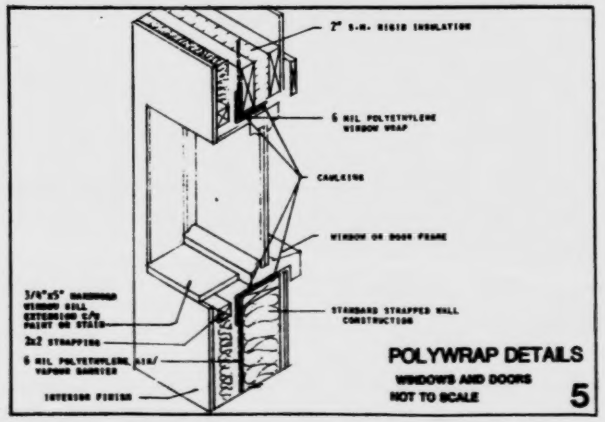

CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 10 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE 3"=1'-0"

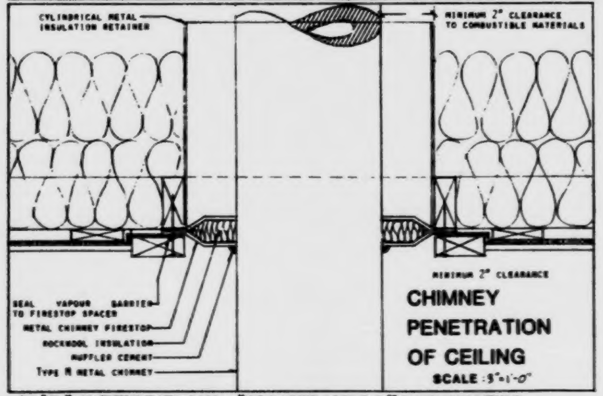

TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPINGS OR STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION

NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE: 3"=1'-0"

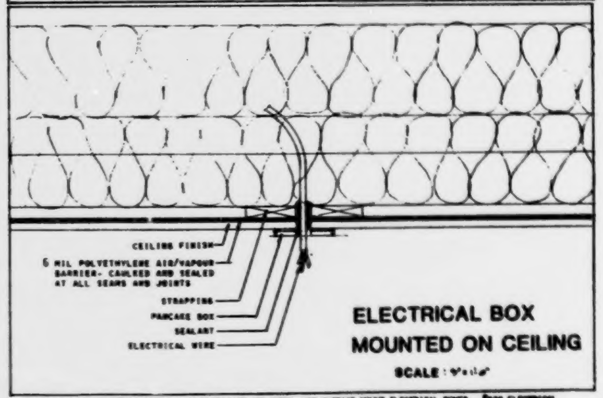

2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
3/4"x5" HARDWOOD WINDOW SILL EXTENSION C/W PAINT OR STAIN
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE
5


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY
MINIMUM 2" CLEARANCE

CHIMNEY PENETRATION OF CEILING
SCALE : 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE : 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. PASS ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS [illegible]

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPENCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS

UTIES Ltd

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13-77 RUE EUGENIE
WPG. MAN.

5

4.3 24' x 32' Plan Design Features

There is approximately 1,536 sq. ft. of useable floor area in this design. The design features are as follows:

- There is an economical use of space as the crawlspace would be constructed anyways (with limited use of its space possible [i.e. storage]). The bi-level design uses the foundation as living area rather than having an unused crawlspace.

- Six bedrooms are possible - 2 on main floor and 4 on lower floor. This still allows room for a storage and work areas or additional separate living space.

- The size of this house allows for lots of storage space.

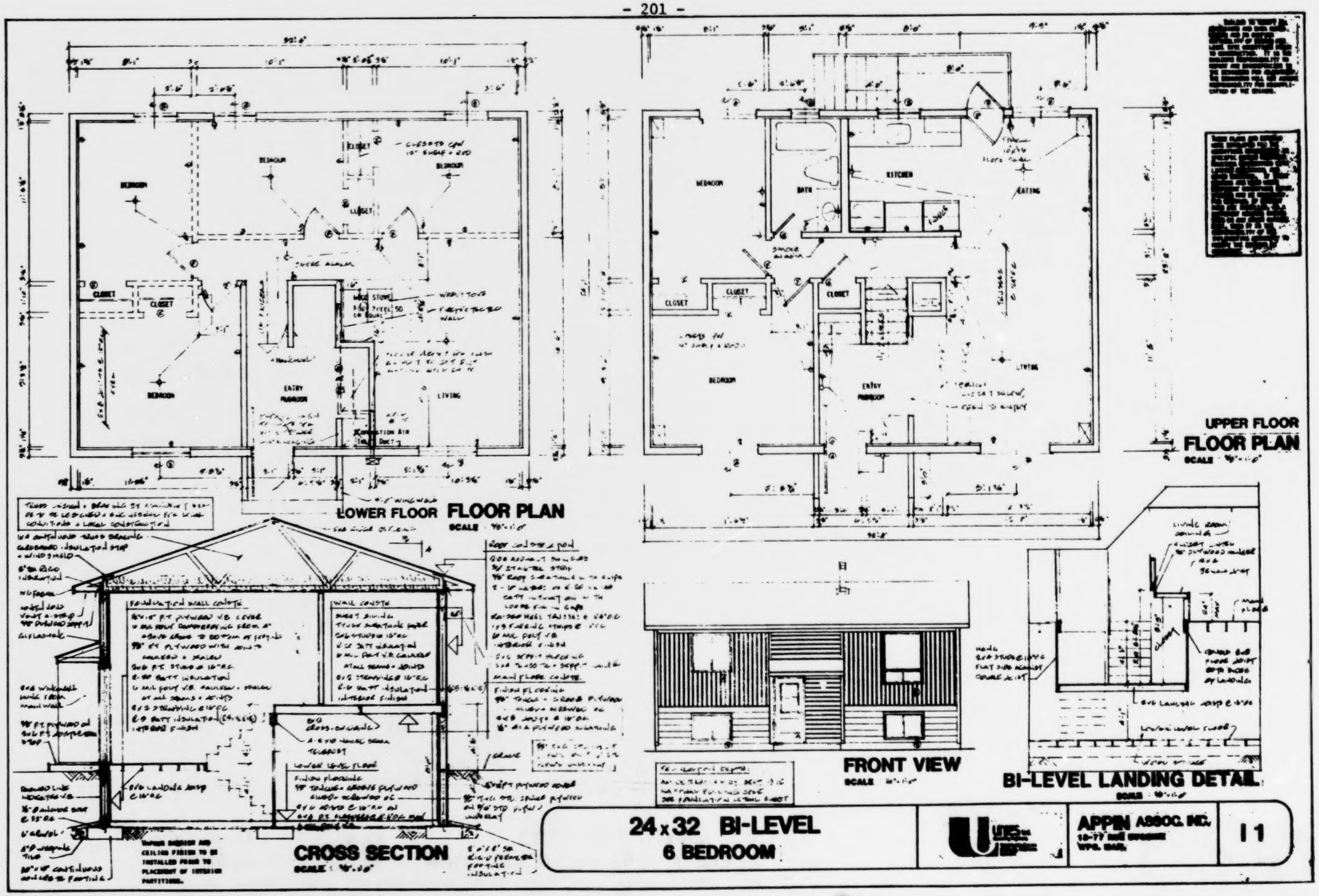
- The mud room is accommodated on the entrance landing. Although it does not constitute a vestibule entry (the addition of a door at the bottom of the staircase would do this). However, this door would restrict heat flow within the house.

- The bathroom located on main floor - approximately 20' from entry.

- A built-in bench seat has been accommodated in the living room. It forms top of the closet located on entrance landing.

- Potential water storage location is under entrance landing (for those houses requiring such facilities).

- The plan has an open feeling with the kitchen, dining, living, and entry stairway because the low wall or the spindled opening between living and entry spaces are all visually connected.


LOWER FLOOR FLOOR PLAN
SCALE
UPPER FLOOR FLOOR PLAN
SCALE
BEDROOM
CLOSET
LIVING
ENTRY
KITCHEN
EATING
BATH
WOOD STOVE
CROSS SECTION
SCALE
FRONT VIEW
SCALE
BI-LEVEL LANDING DETAIL
SCALE
24 x 32 BI-LEVEL
6 BEDROOM
APPIN ASSOC. INC.
11

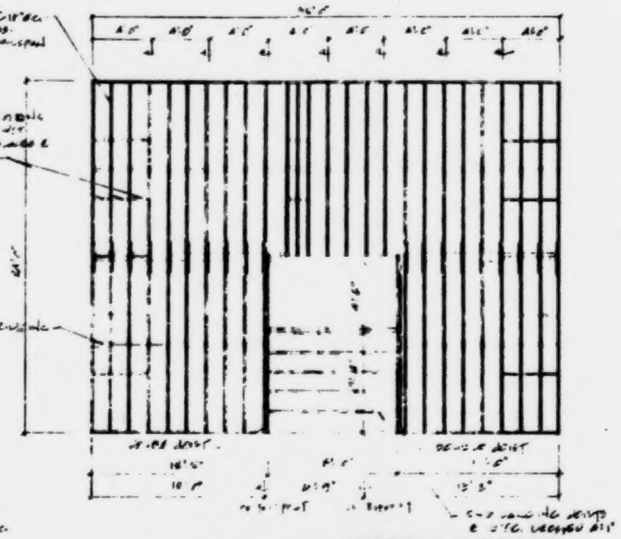
	DOOR SCHEDULE		
	DOOR SIZE	ROUGH OPENING	STYLE
A B	[illegible]		WOOD COMBINATION
C D	[illegible]	[illegible]	INSULATED WOOD ROTARY MAHOGANY
E F G H	[illegible]	[illegible]	HOLLOW CORE ROTARY MAHOGANY
J K L M	[illegible]	[illegible]	BI-FOLD SLAB ROTARY MAHOGANY
N P	[illegible]	[illegible]	BY-PASS SLIDING ROTARY MAHOGANY

	WINDOW SCHEDULE	
	GLASS SIZE	ROUGH OPENING
1	[illegible]	[illegible]
2	[illegible]	[illegible]
3	[illegible]	[illegible]
4	[illegible]	[illegible]
5	[illegible]	[illegible]
6	[illegible]	[illegible]
7	[illegible]	[illegible]

WINDOW SIZES ARE FOR MANUFACTURER SEALED DOUBLE-GLAZED WINDOWS. IF OTHER WINDOWS ARE USED ADJUST ROUGH OPENING SIZE ACCORDINGLY.

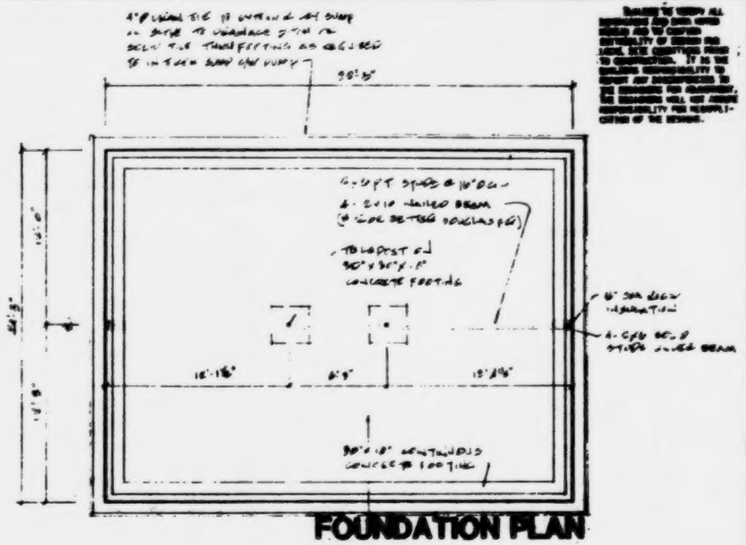
G.I. FLASHING OVER EXTERIOR OPENINGS

2 x 10 LINTELS OVER ALL WINDOW OPENINGS.



UPPER FLOOR **JOIST LAYOUT**

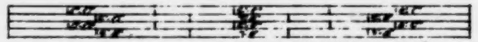
SCALE : [illegible]



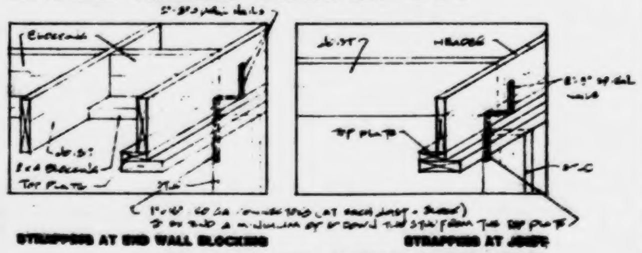
BUILDER TO VERIFY ALL [illegible]

FOUNDATION PLAN

SCALE : [illegible]



NOT TO SCALE **NAILED BEAM LAYOUT**

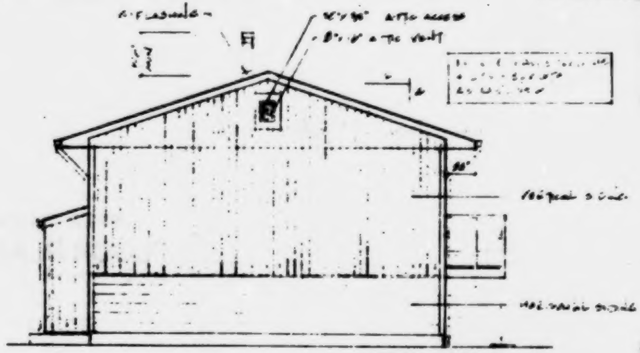


STRAPPING AT END WALL BLOCKING

STRAPPING AT JOIST

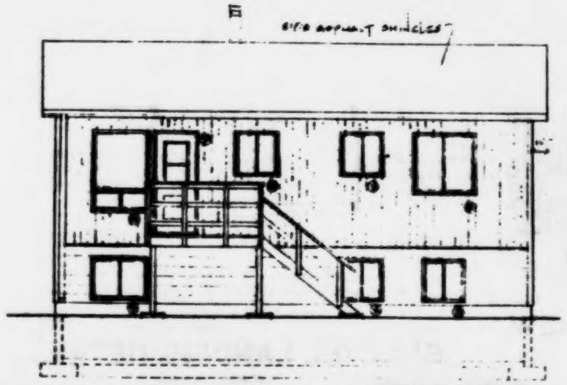
FLOOR FRAMING DETAILS

NOT TO SCALE



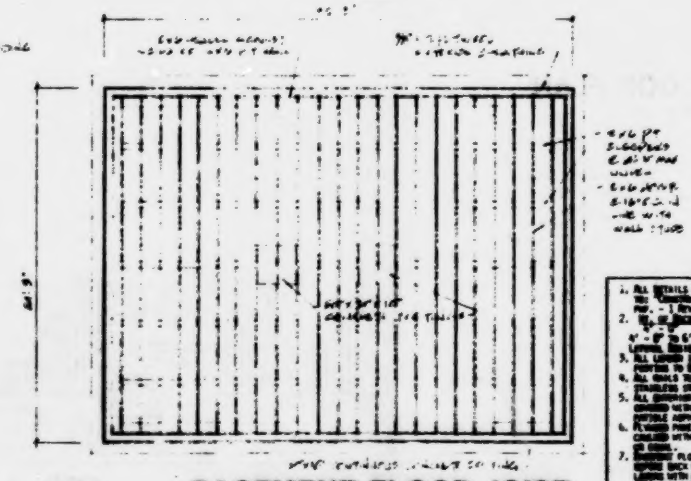
SIDE VIEW

SCALE : [illegible]



REAR VIEW

SCALE : [illegible]



BASEMENT FLOOR JOIST AND SLEEPER LAYOUT

SCALE : [illegible]

1. ALL DETAILS UNLESS NOTED OTHERWISE TO CONFORM TO "CONSTRUCTION GUIDE FOR WOOD FOUNDATIONS" [illegible] – 1 REVISED EDITION.
2. HT. OF BACKFILL [illegible] STUD REQUIREMENTS [illegible] O.C. [illegible] O.C. [illegible]
3. ALL LUMBER IN FOUNDATION FROM TOP PLATE TO FOOTING TO BE PRESSURE TREATED (P.T.)
4. ALL NAILS TO BE USED IN TREATED WOOD ARE TO BE STAINLESS STEEL.
5. ALL EXTERIOR FACES OF FOUNDATION WALLS TO BE COVERED WITH 6 MIL POLY [illegible] WITH COMPATIBLE ASPHALT ADHESIVE TO THE PLYWOOD.
6. PLYWOOD PANEL JOINTS IN FOUNDATION TO BE CAULKED WITH A SEALANT COMPOUND WITH [illegible] OR EQUAL.
7. BASEMENT FLOOR & MAIN FLOOR TO BE IN PLACE BEFORE BACK FILLING. BACK FILL IN UNIFORM LAYERS WITH MAXIMUM DIFFERENCE IN ELEVATION [illegible], HAND TAMP ONLY.
8. OWNER IS RESPONSIBLE FOR CONTACTING THE ENGINEER OR INSPECTOR REGARDING REQUIRED ON SITE INSPECTION OF THE WOOD BASEMENT PRIOR TO BACK-FILL.

[illegible]

EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" HARDBOARD : TYVEC : 3/8" [illegible]
- 3/8" HARDBOARD : TYVEC : PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC : 3/8" GROOVED SHEET SIDING
- TYVEC : 3/8" PLYWOOD SIDING

THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

[illegible]

24 x 32 BI-LEVEL
ELEVATIONS AND FOUNDATION

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18-77 [illegible]
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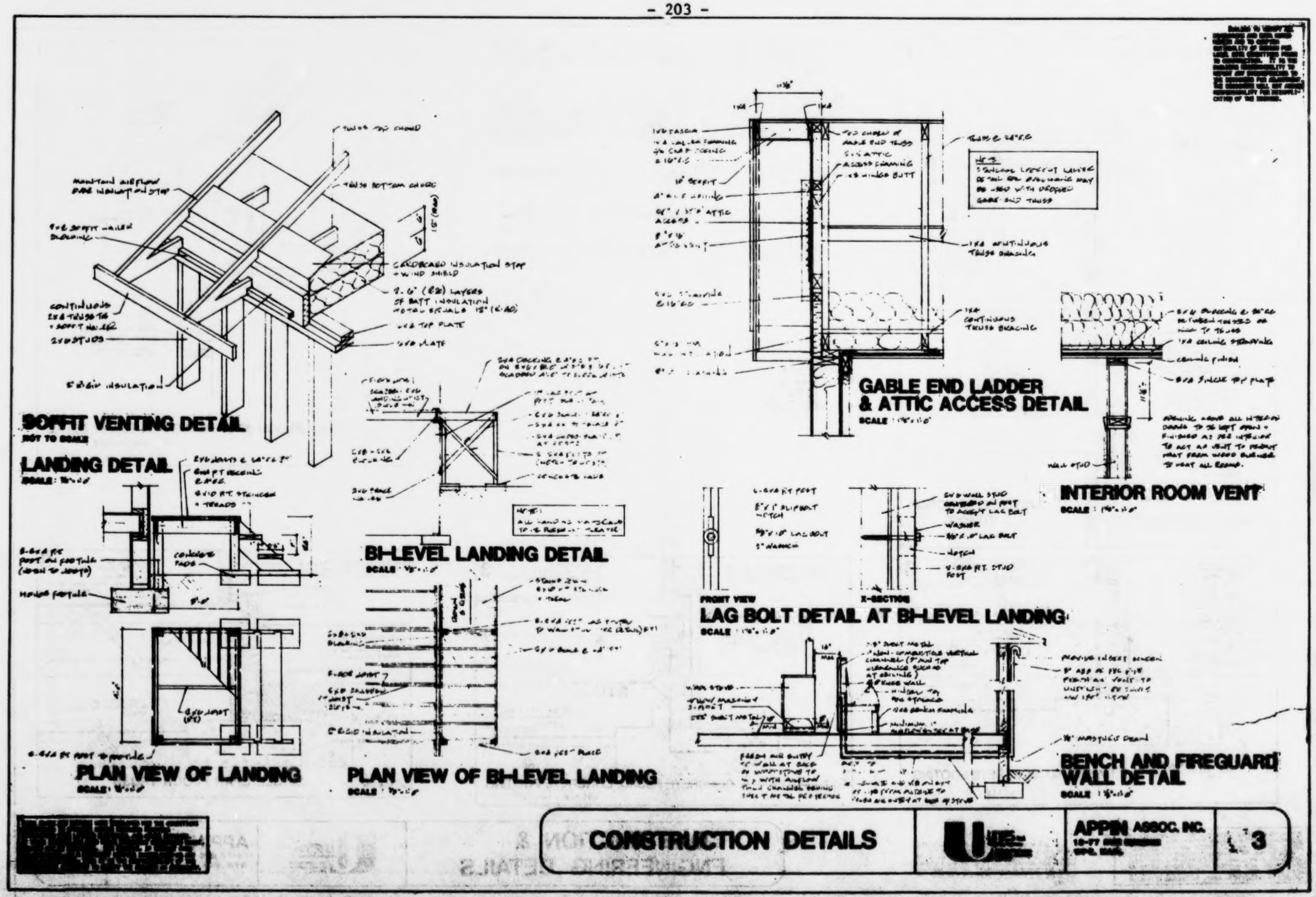
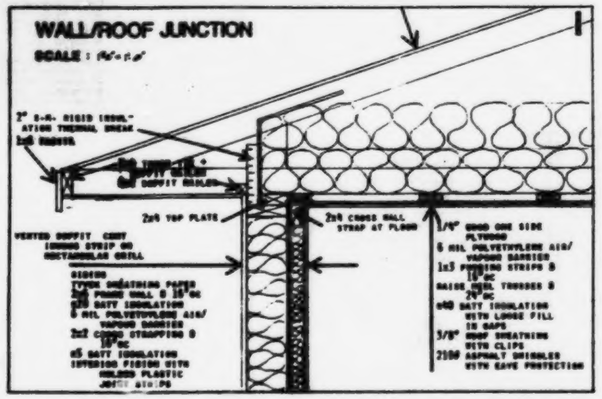
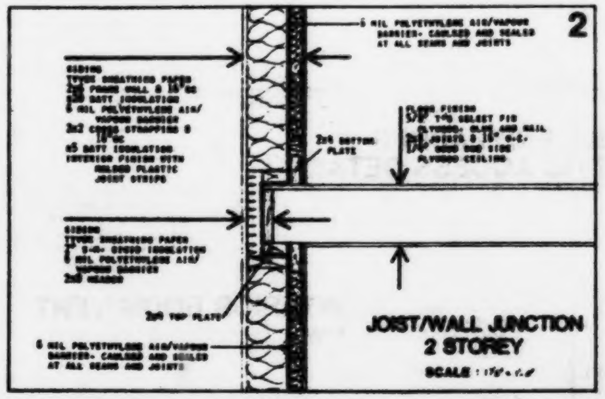
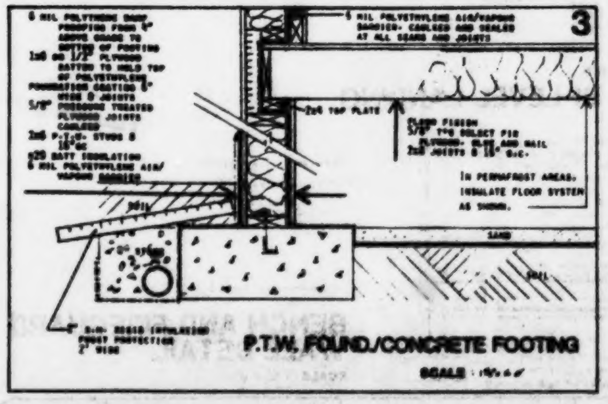
12


SOFFIT VENTING DETAIL
NOT TO SCALE
LANDING DETAIL
BI-LEVEL LANDING DETAIL
GABLE END LADDER & ATTIC ACCESS DETAIL
INTERIOR ROOM VENT
LAG BOLT DETAIL AT BI-LEVEL LANDING
FRONT VIEW
X-SECTION
PLAN VIEW OF LANDING
PLAN VIEW OF BI-LEVEL LANDING
BENCH AND FIREGUARD WALL DETAIL
CONSTRUCTION DETAILS
APPIN ASSOC. INC.
3


WALL/ROOF JUNCTION
SCALE : 1½" = 1'-0"
1
2" S.M. RIGID INSULATION THERMAL BREAK
2x6 RAFTER
SOFFIT BAFFLE
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONT. STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" OC
RAISE HEEL TRUSSES @ 24" OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION


2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
2x4 BOTTOM PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
1/4" GOOD ONE SIDE PLYWOOD CEILING
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
2x4 TOP PLATE
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
JOIST/WALL JUNCTION
2 STOREY
SCALE : 1½" = 1'-0"


3
6 MIL POLYETHYLENE DAMP-PROOFING FROM 6" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x6 TOP PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE
P.T.W. FOUND./CONCRETE FOOTING
SCALE : 1½" = 1'-0"

1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATHING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 x 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

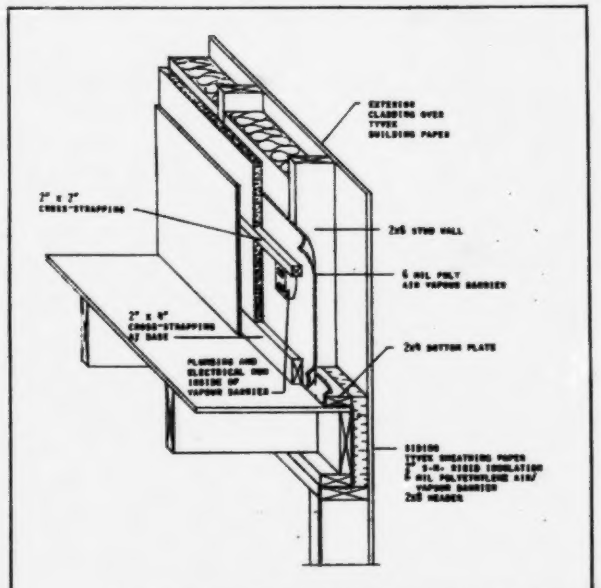
2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR INTERMEDIATE FLOOR JUNCTIONS. AFTER THE LOWER WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL, THE REMAINDER OVER THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL RESTS ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

3 UNHEATED CRAWL SPACE IS ONLY RECOMMENDED WHERE HOUSE IS LOCATED ON PERMAFROST. THE PLYWOOD FLOOR SHEATHING SERVES AS THE FLOOR VAPOUR BARRIER. CAULK THE WALL VAPOUR BARRIER TO THE FLOOR SHEATHING AND CAULK THE SEAMS BETWEEN THE SHEETS OF PLYWOOD. A 6 MIL POLY GROUNDSHEET IS LOCATED UNDER THE HOUSE AND PROTECTED WITH A LAYER OF SAND.

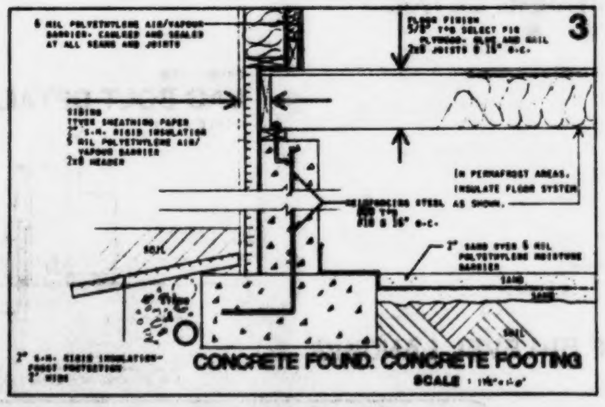
THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).

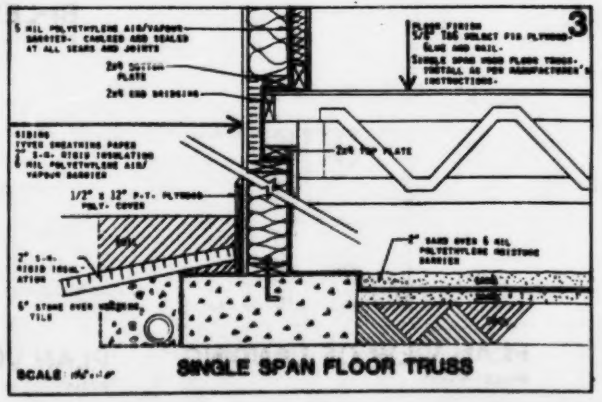
WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. PASS ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD
2x8 JOISTS @ 16" O.C.


EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
2x4 BOTTOM PLATE
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER

WALL/FLOOR JOIST HEADER -CUTAWAY DETAIL
NOT TO SCALE


3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS, INSULATE FLOOR SYSTEM AS SHOWN.
REINFORCING STEEL
SOIL
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SOIL
2" S.M. RIGID INSULATION- FROST PROTECTION 2' WIDE
CONCRETE FOUND. CONCRETE FOOTING
SCALE : 1½" = 1'-0"


3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS. INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P.T. PLYWOOD POLY. COVER
2" S.M. RIGID INSULATION
6" STONE OVER WEEPING TILE
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SCALE : 1½" = 1'-0"
SINGLE SPAN FLOOR TRUSS

CONSTRUCTION &
ENGINEERING DETAILS

UTIES

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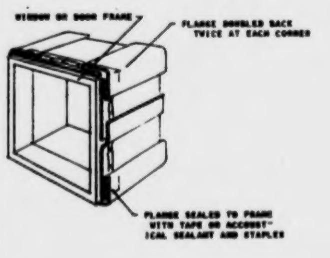
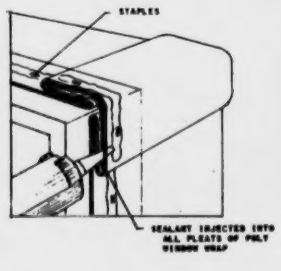

WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

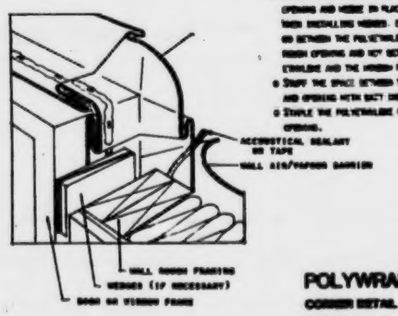
- CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO ONE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

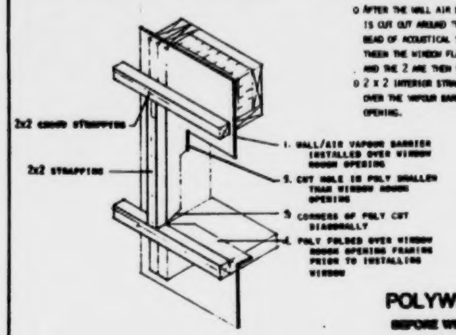
- LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2


ACOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

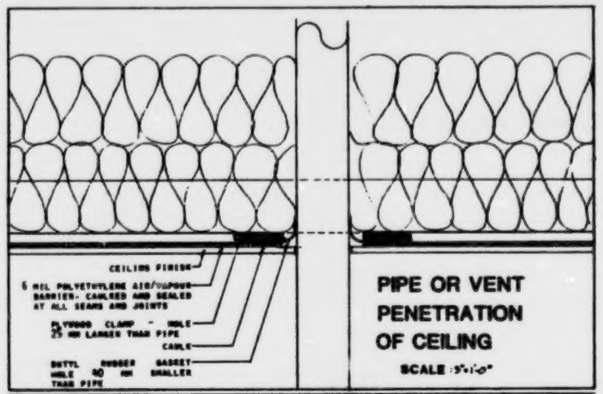
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3

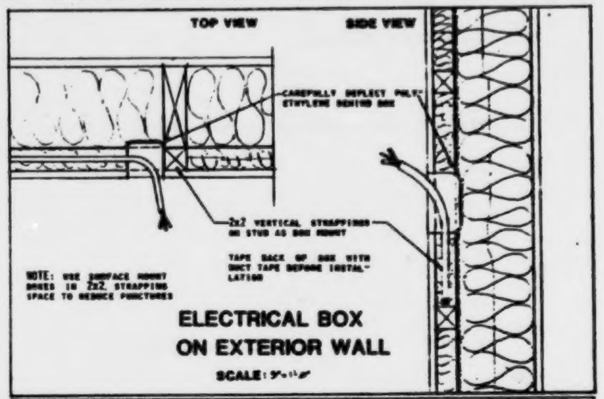

2x2 GROUND STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 x 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4

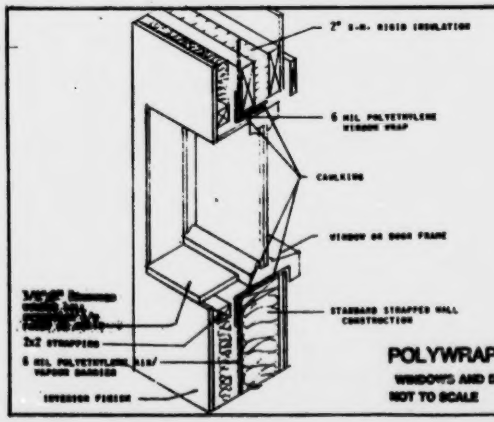

CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 40 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE : 3" = 1'-0"

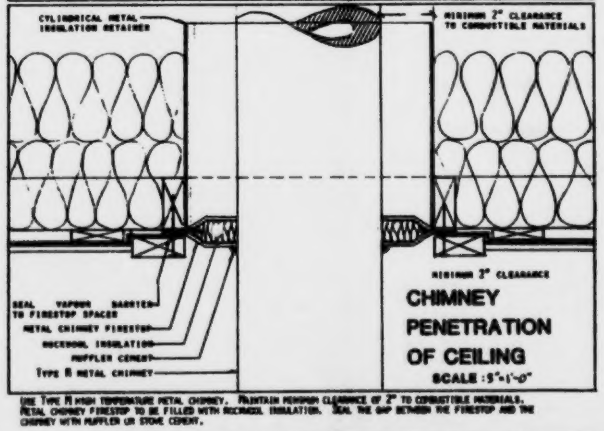

TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPING ON STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION

NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE : 3" = 1'-0"

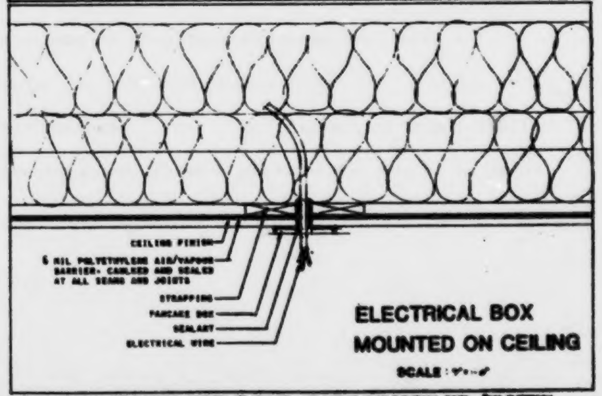

2" E.R. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE
5


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
MINIMUM 2" CLEARANCE
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY

CHIMNEY PENETRATION OF CEILING
SCALE : 3" = 1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE : 3" = 1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

[illegible]

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGN.

CONSTRUCTION & ENGINEERING DETAILS

UTIES Ltd.

APPIN ASSOC. INC.
13-77 [illegible]
WPG. MAN.

5

V. TWO STOREY DESIGNS

The same comments for the bi-level designs apply to the 2-storey designs. They are not a common house form in the north. Yet, given the variety of family housing needs, one needs to have a variety of housing designs. Appendices I & II outline the generally positive response to the two storey designs.

The three 2-storey plans developed by the Design Team are as follows:

1. 16' x 28' (4 br)
2. 18' x 26' (4 br)
3. 20' x 24' (1 3/4 storey - 4 br)

The plans and elevations of each of the designs is shown in turn. The complete set of drawings for the 16' x 28' house is shown for illustrative purposes. For more detailed information, readers are referred to the construction drawings under separate cover.

5.1 Engineering Design Considerations and Solutions for the 2-Storey Designs

Component	Problem	Proposed Solution
Foundation	Variations in soil conditions, house styles and materials costs between communities make it impossible to identify a single "best" foundation design for northern housing. Settling and heaving of foundations in some communities causes structural damage to the houses. High humidity in crawl spaces causes deterioration of floor system.	A variety of foundation designs were prepared, making it possible for the builder to choose the most economical foundation for each project. Any of the house designs can be built using clear span, prefabricated floor trusses. All plans specify 6 mil poly ground sheets under crawl spaces to control ground source moisture problems. Crawl spaces have vents designed to be opened in the summer to air dry the crawl space.
Floor System	Floor tiles, especially at entrances, lift off. Floors are cold.	Use of sheet flooring is recommended. Heated crawl spaces with insulated walls are recommended.
Exterior Walls	The climate in the north dictates that the house exterior walls have high insulation levels and be of airtight construction. Finishes must be study. Construction must be simple and straightforward, reflecting the manpower, equipment and financial constraints common to native housing projects.	All exterior walls are 2 x 6 frame construction, cross strapped with 2 x 2's on the interior. The vapour barrier is located between the 2 x 6 and 2 x 2 framing. The entire wall cavity is filled with with insulation, yielding R-25 walls with only minimal amounts of thermal bridging. Wiring in outside walls is located completely inside the vapour barrier reducing the number of perforations in the vapour barrier. Heavier exterior cladding than those currently used are recommended. Wall construction is simple, and not much diffierent than is currently being built in the native communities.
Windows	Windows are a major source of heat loss in northern housing. This is due to air leakage around the window frame and within the window unit.	Non operating windows are specified wherever possible. The size of operating windows is minimized. "Lexan" plastic windows are not recommended because they may prevent windows from serving as an exit in event of a fire.
Exterior Doors	Snow hinging and cold weather failure of weatherstripping are common problems.	It is recommended that insulated steel exterior doors be used. Doors to be double weatherstripped. Use four 4-screw door hinges with 3" long screws which screw through into the framing around the rough opening. An attached porch detail is included with most house plans. Porches reduce snow accumulation on door jambs and threshholds.

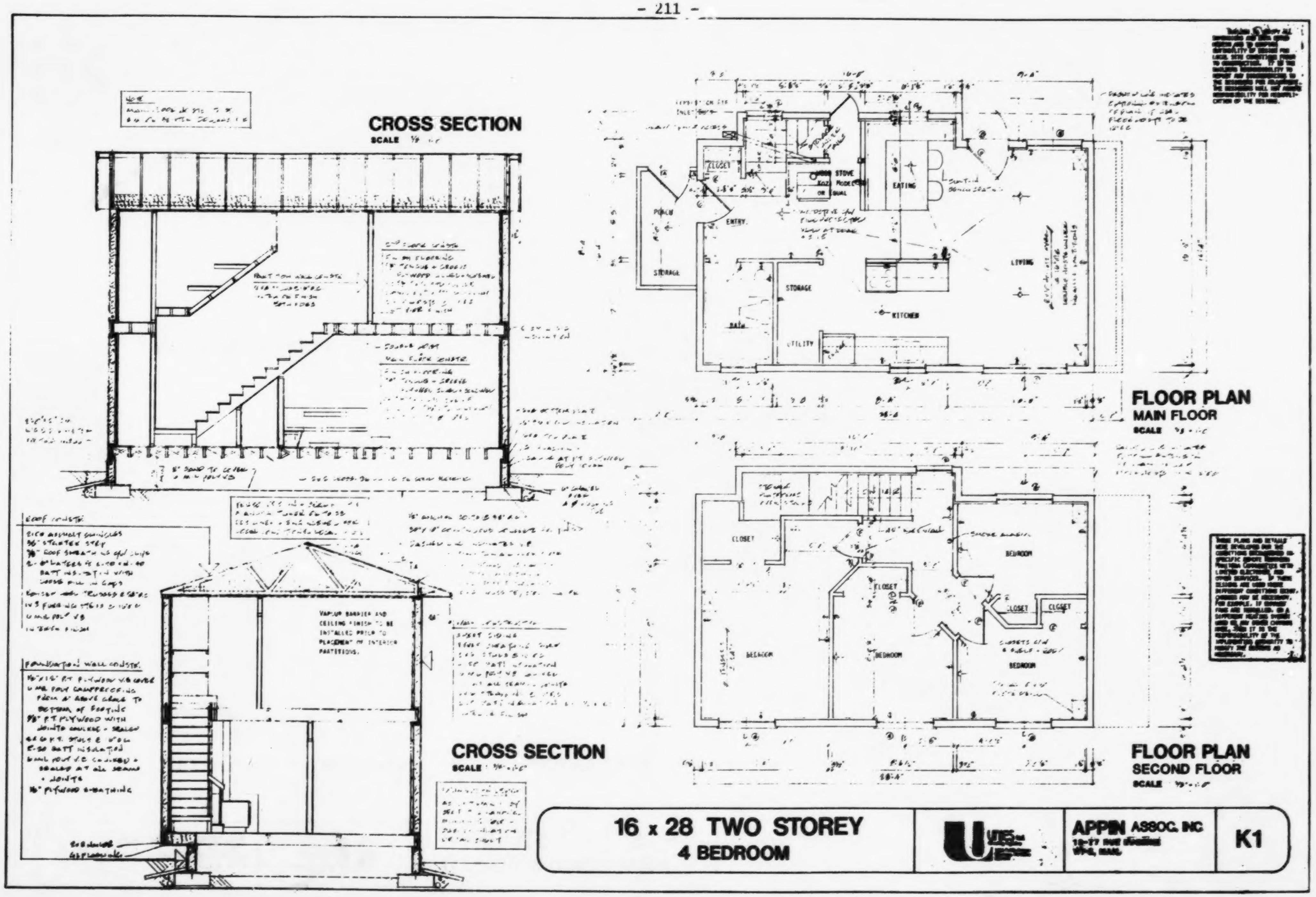
Component	Problem	Proposed Solution
	Doors are hard to open when wearing mitts.	Lever type openers with D-ring handles are recommended.
Ceilings and Roofs	Moisture accumulation in attics is a major cause of ceiling damage.	Specifications call for a continuous 6 mil poly vapour barrier sealed at all seams and penetrations in the ceiling. The vapour barrier and ceiling finish are to be installed prior to placement of interior partitions. Raised heel trusses are specified. An insulation retainer and wind shield minimizies the amount of snow blowing in the soffits and into the insulation. It also helps keep outside ceiling corners warm, reducing condensation problems. The designs minimize the number of ceiling mounted electrical fixtures, thus the number of penetrations in the ceiling vapour barrier.
Heating and Ventilation	Fire safety is a significant concern wherever wood heating is used.	Well constructed, airtight wood stoves with brick liners are specified. All stoves to be mounted on non combustible surfaces and adjacent walls are protected by metal shielding conforming to CSA Can 3-B365-M84. Where closer clearances to walls are required, shielded stoves are specified. Type M, high temperature chimneys are specified.
	An outside air supply is required for combustion appliances in energy efficient houses. Ventilation air is required to control indoor humidity. Mechanical ventilation is impractical in housing equipped with 15 amp service. Cold ventilation air must not reduce occupant comfort, or attempts may be made to block the fresh air inlet. This could cause stove backdrafting, and create a health hazard due to smoke or carbon monoxide build-up in the house.	An outside air supply duct has been designed to introduce fresh air through the wall behind the heat shielding near the stove. The fresh air will be warmed by the shield, and will mix with house air, providing ventilation for occupant comfort. This fresh air inlet location greatly reduces the likelihood of the occupant blocking off the inlet. The stove draws combustion air from the space around it, thus removing stale air and humidity from the house.
	Moving heat from the stove to the far reaches of the house is difficult without the use of fans and ductwork.	To facilitate air movement throughout the house, the stove is located in the lower level, near the stairwell. The stairwell is open allowing heat to rise to the second floor. Grilles located in each corner, allow this air to flow back down to the lower level as it cools along the outside walls. The open stairwell and floor grilles allow the air to circulate throughout the house. The stove on the lower level reheats the cool return air and it again rises into the upper level. High wall grilles allow warm air to circulate into closed rooms. Undercutting doors allows cool air to flow out of rooms.

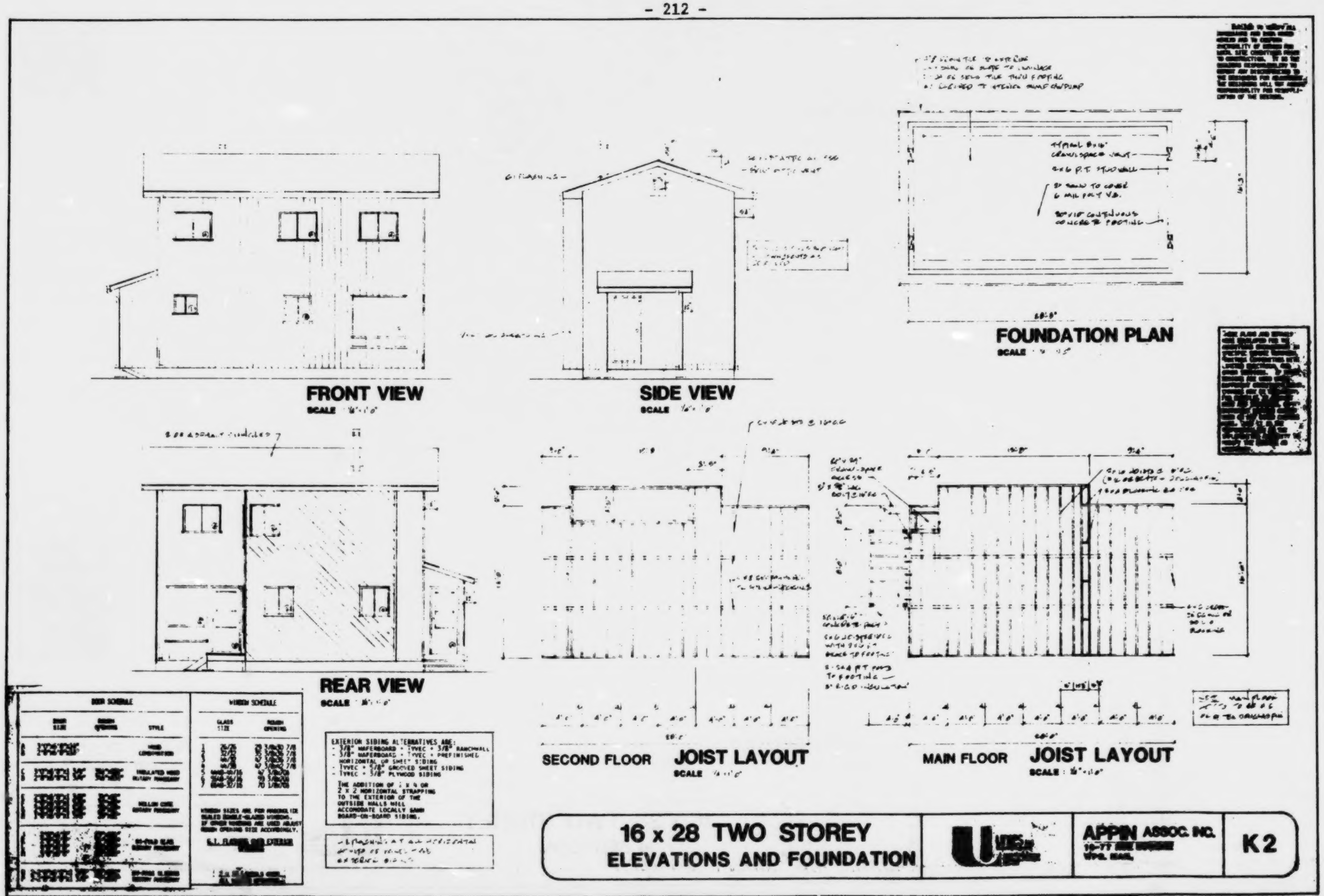
Component	Problem	Proposed Solution
	Heating the crawl space is a problem because heat rises from the stove and thermal stratification, inhibits air movement from the house into the crawl space.	Floor grilles near the back of the wood heater will encourage air to convect up past the wood stove. Floor grilles around the perimeter of the house will allow house air to flow down into the crawl space warming it slightly. This, combined with radiant and conductive heat flow from the floor should maintain acceptable temperatures in the crawl space.
Water Supply and Waste Disposal Systems	If indoor plumbing services or trucked water systems are introduced to the community, conversion of existing housing stock to benefit from these systems is difficult.	Many of the house designs have areas that are well suited for locating water storage tanks. Where practical, washrooms and kitchens are located back to back, to facilitate joint plumbing. Heated crawl spaces make servicing from the crawl space feasible.
Electrical Systems	Wiring in conventional housing results in numerous perforations in the poly vapour barrier.	All wiring is to be done from the crawl space (unless the floor system is insulated and the crawl space is unheated) thus reducing penetrations through the ceiling vapour barrier. As much as possible wiring should be done on interior paritions. The vapour barrier on outside walls is set back sufficiently into the wall to allow all wiring to be run inside the vapour barrier.

5.2 16' x 28' 2 Storey (4 bedroom) Design Features

There is approximately 896 sq. ft. of useable floor area in this design. The design features are as follows:

- The 16' width allows for clear span floor joists, thus eliminating the need for a centre beam and teleposts.
- The exit is directly accessible from the bathroom which is important for those houses utilizing the "honey bucket" system.
- The open plan style on main floor allows for an unobstructed view down the length of the house.
- The utility space provided between bathroom and kitchen with room for a hot water tank, washer and dryer, (or it could be used for storage).
- The wood space heater is located beside staircase, and directly opposite from the kitchen. This allows for its use as a cooking surface.
- The stairway allows for heat flow to the second floor.
- The pass-through from the exterior (located under the stairs) allows for an intermediate storage area for wood before it is burned in the stove.
- The layout of the second floor allows for four bedrooms as well as a storage area over the stairs which is accessible from the master bedroom.
- The vestibule entry and storage area incorporated by an addition to the end of the house (covered with a shed roof).
- The dining area is located in such a position as to use the space effectively under the stairs. The dining table and bench seating along its two sides could be built-in units.


CROSS SECTION
SCALE
FLOOR PLAN
MAIN FLOOR
SCALE
PORCH
ENTRY
CLOSET
WOOD STOVE
EATING
LIVING
STORAGE
STORAGE
BATH
UTILITY
KITCHEN
CLOSET
CLOSET
BEDROOM
CLOSET
CLOSET
BEDROOM
BEDROOM
BEDROOM
VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.
CROSS SECTION
SCALE
FLOOR PLAN
SECOND FLOOR
SCALE
16 x 28 TWO STOREY
4 BEDROOM
APPIN ASSOC. INC
K1


FRONT VIEW
SCALE
SIDE VIEW
SCALE
FOUNDATION PLAN
SCALE
REAR VIEW
SCALE
SECOND FLOOR JOIST LAYOUT
SCALE
MAIN FLOOR JOIST LAYOUT
SCALE
DOOR SCHEDULE
STYLE
WINDOW SCHEDULE
GLASS SIZE
ROUGH OPENING

WINDOW SIZES ARE FOR NOMINAL [illegible] SEALED SINGLE-GLAZED WINDOWS. IF OTHER WINDOWS ARE USED ADJUST ROUGH OPENING SIZE ACCORDINGLY.

EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" WAFERBOARD + TYVEC + 3/8" RANCHWALL
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

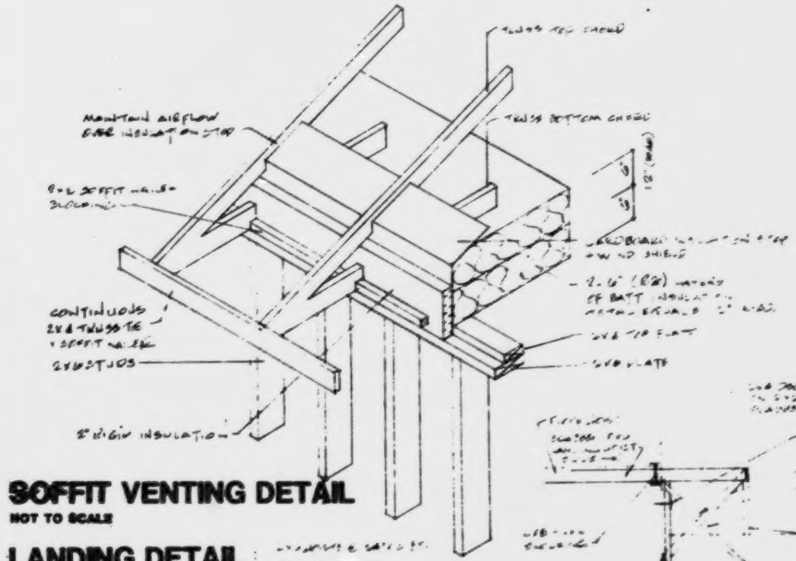
THE ADDITION OF 1 X 4 OR 2 X 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

16 x 28 TWO STOREY
ELEVATIONS AND FOUNDATION

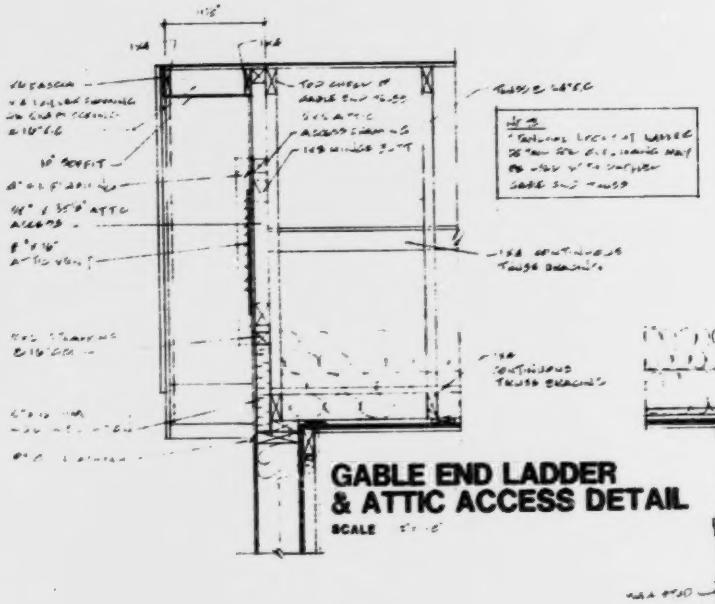
APPIN ASSOC. INC.

K2

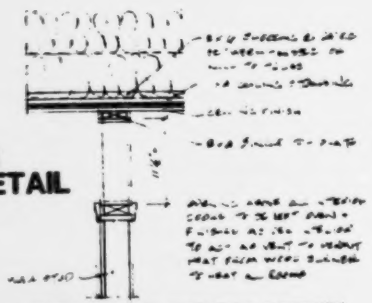
[illegible] TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.


TRUSS TOP CHORD
MAINTAIN AIRFLOW OVER INSULATION STOP
TRUSS BOTTOM CHORD
SOFFIT NAILER BLOCKING
CONTINUOUS 2X4 TRUSS TIE + SOFFIT NAILER
2X6 STUDS
2" RIGID INSULATION
2X4 TOP PLATE
2X6 PLATE

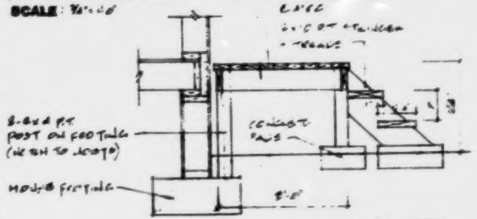
SOFFIT VENTING DETAIL
NOT TO SCALE


1X4
10" SOFFIT
ATTIC VENT
TRUSS @ 24" O.C.
1X4 CONTINUOUS TRUSS BRACING

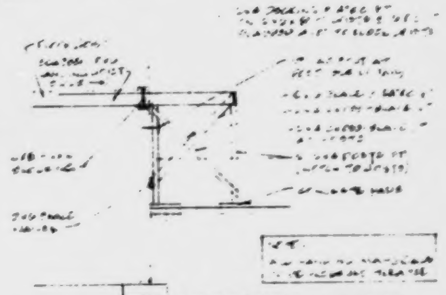
GABLE END LADDER & ATTIC ACCESS DETAIL
SCALE



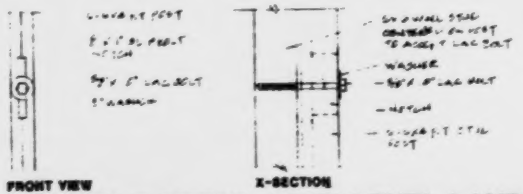
INTERIOR ROOM VENT
SCALE


HOUSE FOOTING

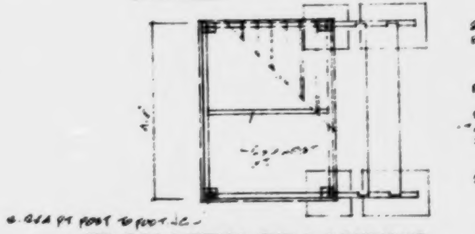
LANDING DETAIL
SCALE



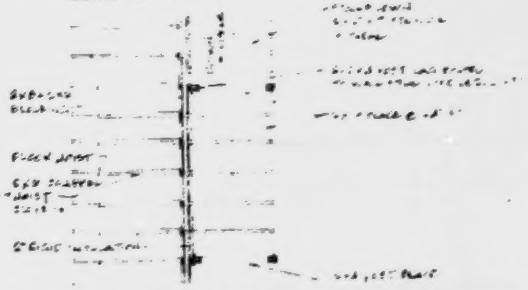
BI-LEVEL LANDING DETAIL
SCALE


FRONT VIEW
X-SECTION
WASHER

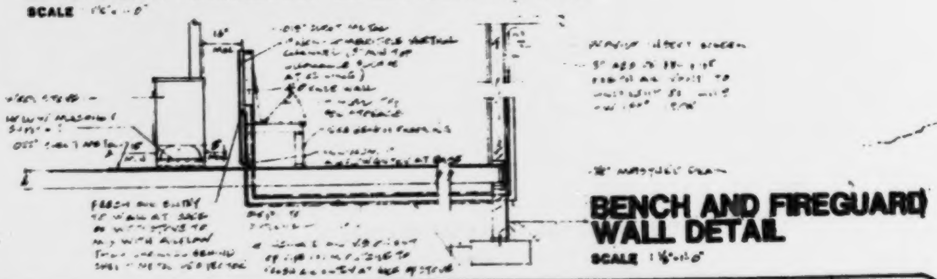
LAG BOLT DETAIL AT BI-LEVEL LANDING
SCALE



PLAN VIEW OF LANDING
SCALE


FLOOR JOIST
2" RIGID INSULATION

PLAN VIEW OF BI-LEVEL LANDING
SCALE



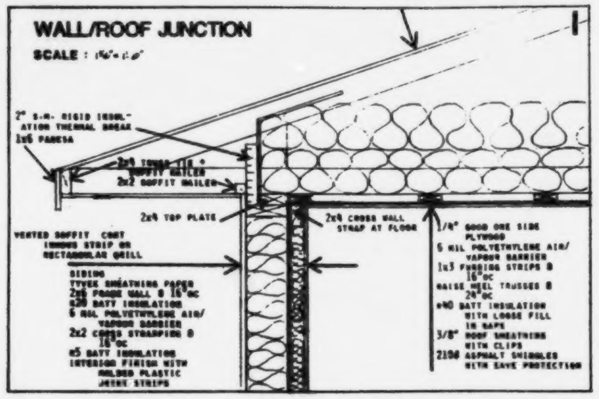
BENCH AND FIREGUARD WALL DETAIL
SCALE

[illegible]

CONSTRUCTION DETAILS

APPIN ASSOC. INC.

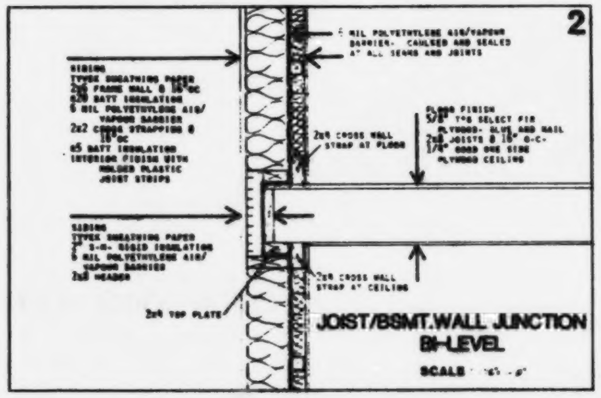
3



WALL/ROOF JUNCTION

SCALE : 1½" = 1'-0"

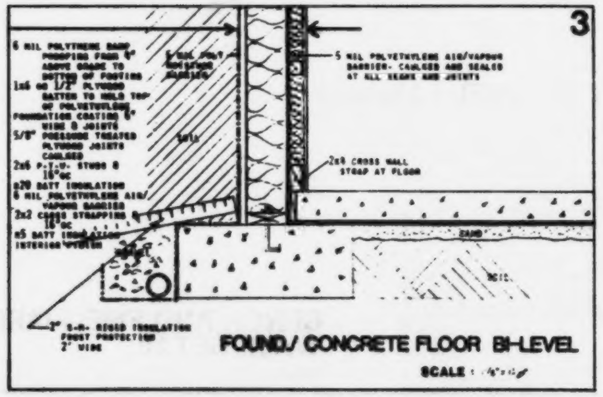
1
2" S.M. RIGID INSULATION THERMAL BREAK
1x6 FASCIA
2x4 TRUSS TIE + SOFFIT NAILER
2x2 SOFFIT NAILER
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONT. [illegible] STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" OC
RAISE HEEL TRUSSES @ 24" OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION



JOIST/BSMT.WALL JUNCTION BI-LEVEL

SCALE : 1½" = 1'-0"

2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOIST STRIPS
2x4 CROSS WALL STRAP AT FLOOR
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD- GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
1/4" GOOD ONE SIDE PLYWOOD CEILING
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
2x4 CROSS WALL STRAP AT CEILING
2x4 TOP PLATE



FOUND./ CONCRETE FLOOR BI-LEVEL

SCALE : 1½" = 1'-0"

3
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
6 MIL POLY MOISTURE BARRIER
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH
SOIL
5 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 CROSS WALL STRAP AT FLOOR
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE

1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATHING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 x 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

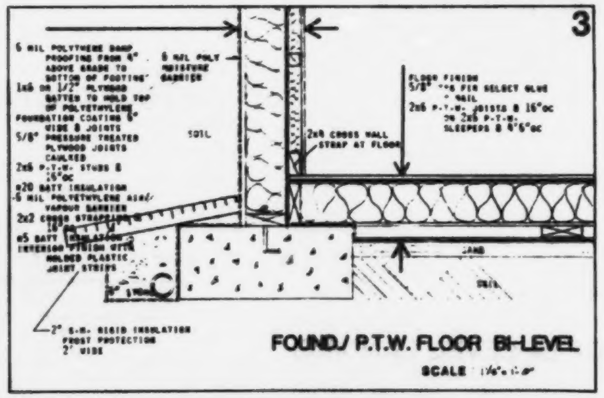
2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR THE JUNCTION BETWEEN THE FIRST FLOOR AND A PRESERVED WOOD FOUNDATION. AFTER THE FOUNDATION WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL, THE REMAINDER HANGS DOWN ON THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL IS PLACED ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

3 THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. PASS ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

NOTE: ALL FLOOR JOISTS CHANGED TO

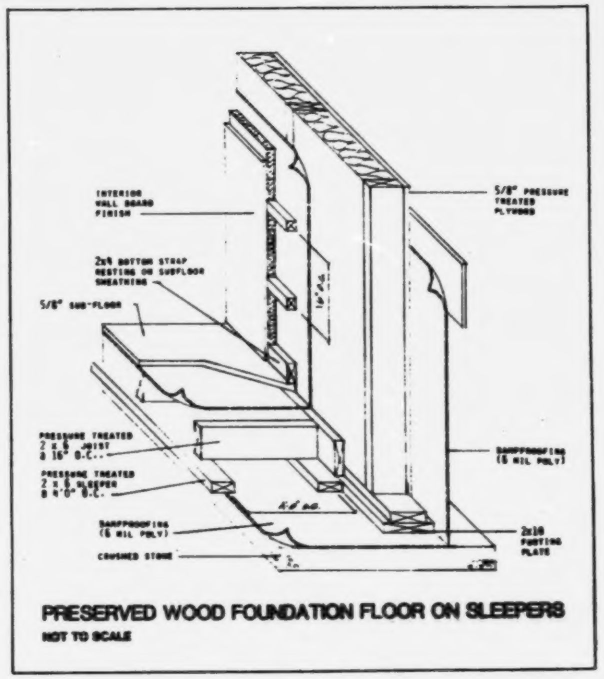
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD ON 5/8"
T&G STD. SPRUCE PLY.
C/W 5/16" STD. PLY.
UNDERLAY. GLUE & NAIL
2x8 JOISTS @ 16" O.C.



FOUND./ P.T.W. FLOOR BI-LEVEL

SCALE : 1½" = 1'-0"

3
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
6 MIL POLY MOISTURE BARRIER
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
SOIL
2x4 CROSS WALL STRAP AT FLOOR
FLOOR FINISH
5/8" T&G FIR SELECT GLUE & NAIL
2x6 P.T.W. JOISTS @ 16" OC ON 2x6 P.T.W. SLEEPERS @ 4'6" OC
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE



PRESERVED WOOD FOUNDATION FLOOR ON SLEEPERS

NOT TO SCALE

INTERIOR WALL BOARD FINISH
2x4 BOTTOM STRAP RESTING ON SUBFLOOR SHEATHING
5/8" SUB-FLOOR
16" O.C.
5/8" PRESSURE TREATED PLYWOOD
PRESSURE TREATED 2 x 6 JOIST @ 16" O.C.
PRESSURE TREATED 2 x 6 SLEEPER @ 4'0" O.C.
4'-0" O.C.
DAMPPROOFING (6 MIL POLY)
DAMPPROOFING (6 MIL POLY)
CRUSHED STONE
2x10 FOOTING PLATE

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS [illegible]

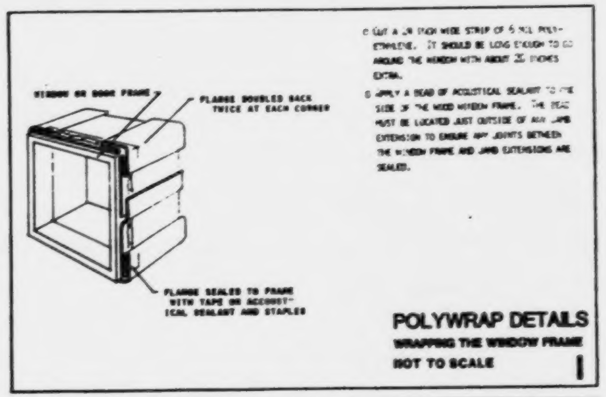
BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPENCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS

UNIES

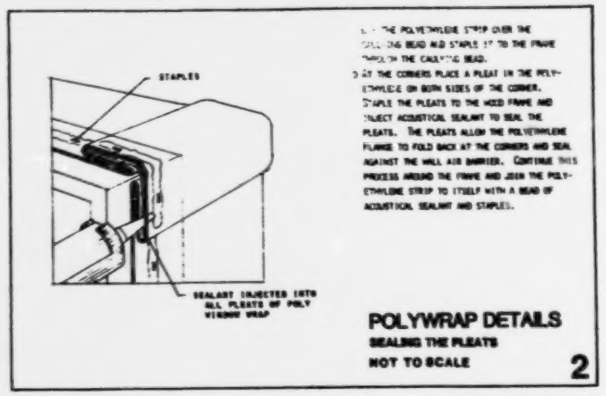
APPIN ASSOC. INC.
13-77 [illegible]
WPG. MAN.

4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLES

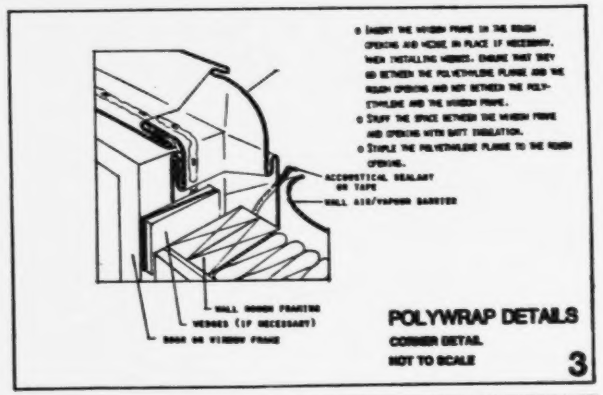
- CUT A 20 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO THE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE **1**


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

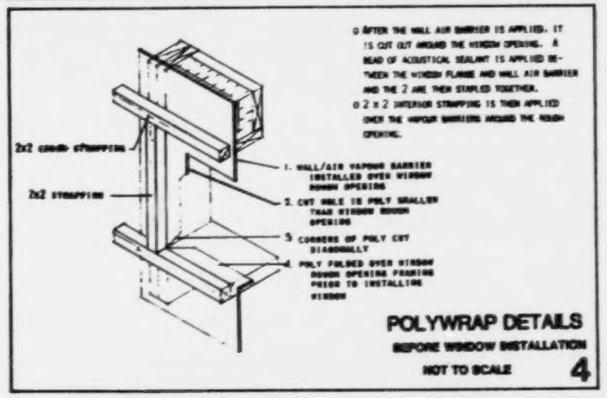
- LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE **2**


ACCOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

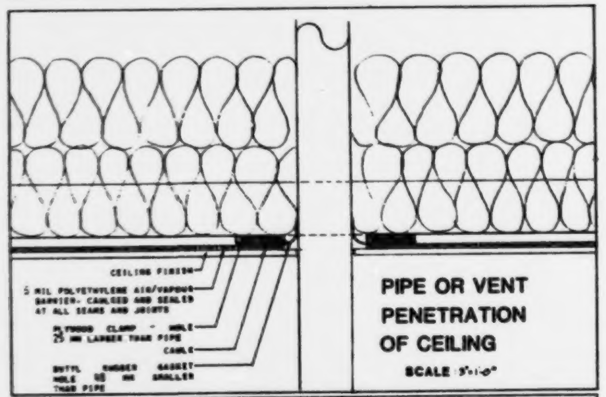
- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE **3**

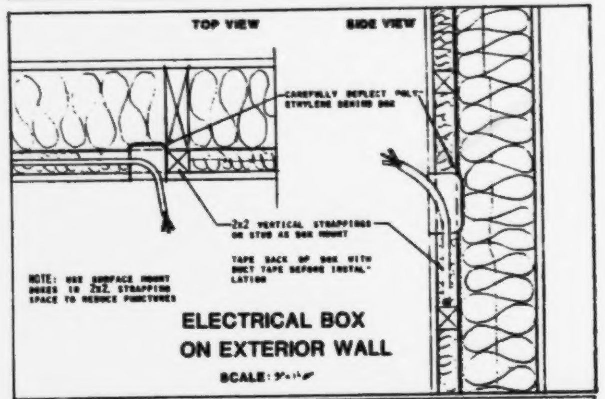

2x2 CROSS STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3 CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 x 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE **4**

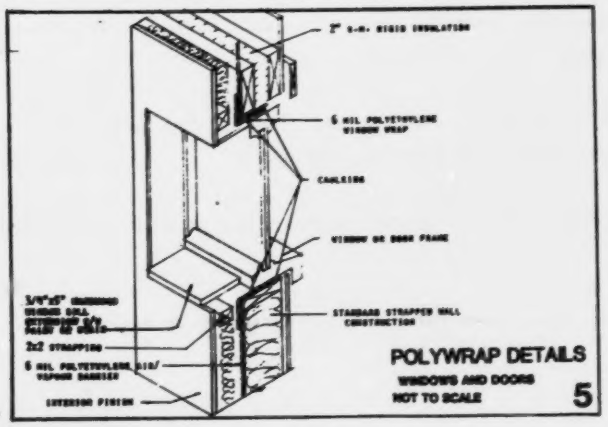

CEILING FINISH
5 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 10 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE 3"=1'-0"

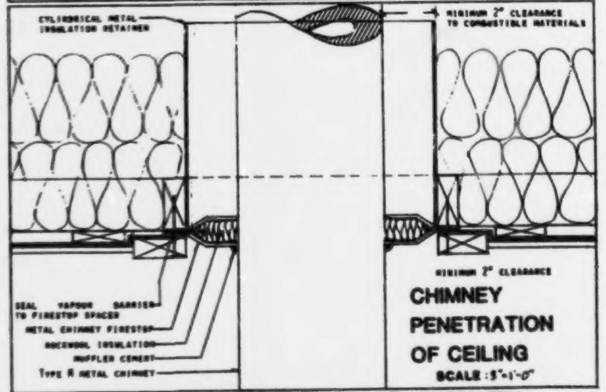

TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPINGS OR STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION

NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE: 3"=1'-0"

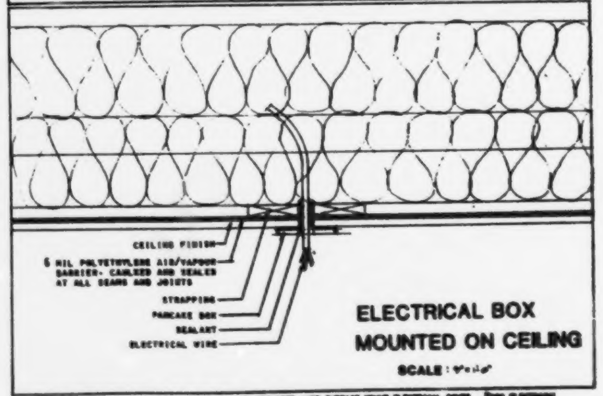

2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
3/4"x5" [illegible]
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE **5**


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
MINIMUM 2" CLEARANCE
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY

CHIMNEY PENETRATION OF CEILING
SCALE : 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE : 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

[illegible]

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS

UNIES Ltd

APPIN ASSOC. INC.
13-77 RUE EUGENE
WPG. MAN.

5

5.3 18' x 26' 2 Storey (4 Bedroom) Design Features

There is approximately 936 sq. ft. of useable floor area in this design. The design features are as follows:

- The layout is basically the same as the 18' x 26' bilevel except that the floors have been reversed (i.e. second floor is comprised of the bedrooms and the ground floor is the main living area.

- The bathroom is located on main floor, and close to the side exit from the house.

- A storage shed addition permits a winter vestibule entrance for the house.

- The open plan style is possible through the use of low walls between dining and living rooms, and kitchen and dining room.

- Storage provided under the stairs, as well as in vestibule entry storage shed.

- The wood stove is located on main floor, thus providing easy access for using it as a cooking surface.

- The 18' width allows for the optional use of clear span floor joists.

- The dining area allows for built-in seating to be used.

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DOOR SCHEDULE

	DOOR SIZE	ROUGH OPENING	STYLE
A B	[illegible] [illegible]		WOOD COMBINATION
C D	[illegible] [illegible]	[illegible] [illegible]	INSULATED WOOD ROTARY MAHOGANY
E F G H	[illegible]	[illegible]	HOLLOW CORE ROTARY MAHOGANY
J K L M	[illegible]	[illegible]	BI-FOLD SLAB ROTARY MAHOGANY
N P	[illegible]	[illegible]	BY-PASS SLIDING ROTARY MAHOGANY

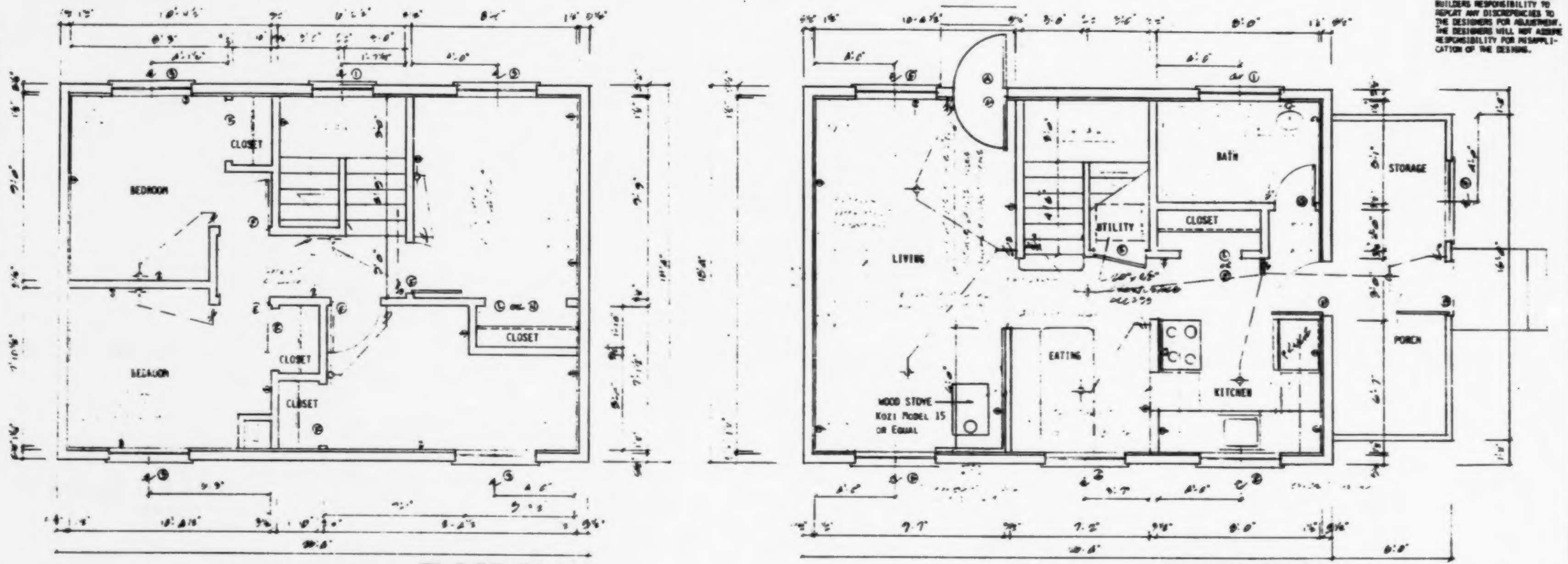
WINDOW SCHEDULE

	GLASS SIZE	ROUGH OPENING
1	[illegible]	[illegible]
2	[illegible]	[illegible]
3	[illegible]	[illegible]
4	[illegible]	[illegible]
5	[illegible]	[illegible]
6	[illegible]	[illegible]
7	[illegible]	[illegible]

WINDOW SIZES ARE FOR MANUFACTURED SEALED DOUBLE-GLAZED WINDOWS. IF OTHER WINDOWS ARE USED ADJUST ROUGH OPENING SIZE ACCORDINGLY.

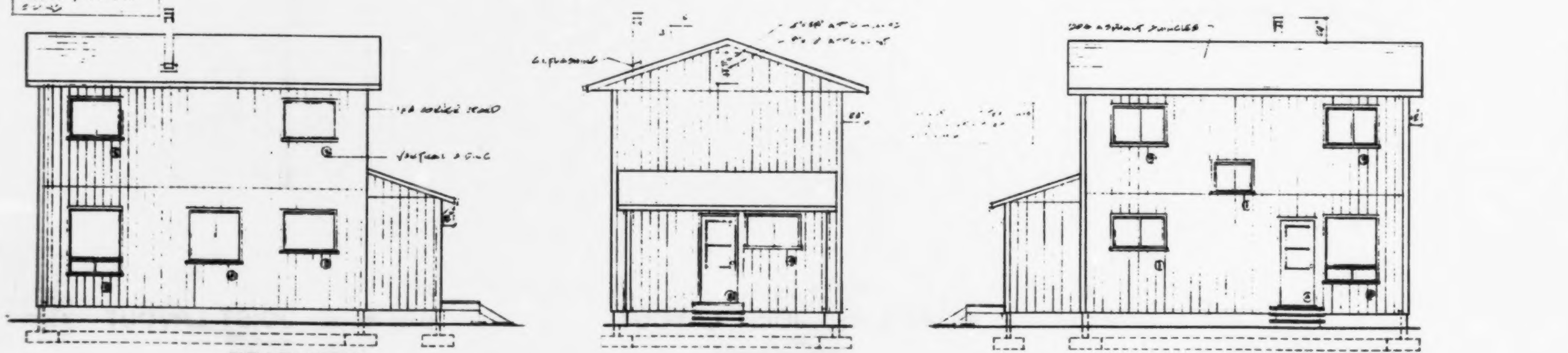
G.I. FLASHING OVER EXTERIOR OPENINGS

2 x 10 LINTELS OVER ALL WINDOW OPENINGS.



SECOND FLOOR **FLOOR PLAN**
SCALE: 3/16" = 1'0"

MAIN FLOOR **FLOOR PLAN**
SCALE: 3/16" = 1'0"



REAR VIEW
SCALE: 1/4" = 1'-0"

SIDE VIEW
SCALE: 1/4" = 1'0"

FRONT VIEW
SCALE: 1/4" = 1'0"

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EXTERIOR SIDING ALTERNATIVES ARE:
- 3/8" WAFERBOARD + TYVEC + 3/8" RANCHWALL
- 3/8" WAFERBOARD + TYVEC + PREFINISHED HORIZONTAL OR SHEET SIDING
- TYVEC + 5/8" GROOVED SHEET SIDING
- TYVEC + 3/8" PLYWOOD SIDING

THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

18 x 26 TWO STOREY
4 BEDROOM

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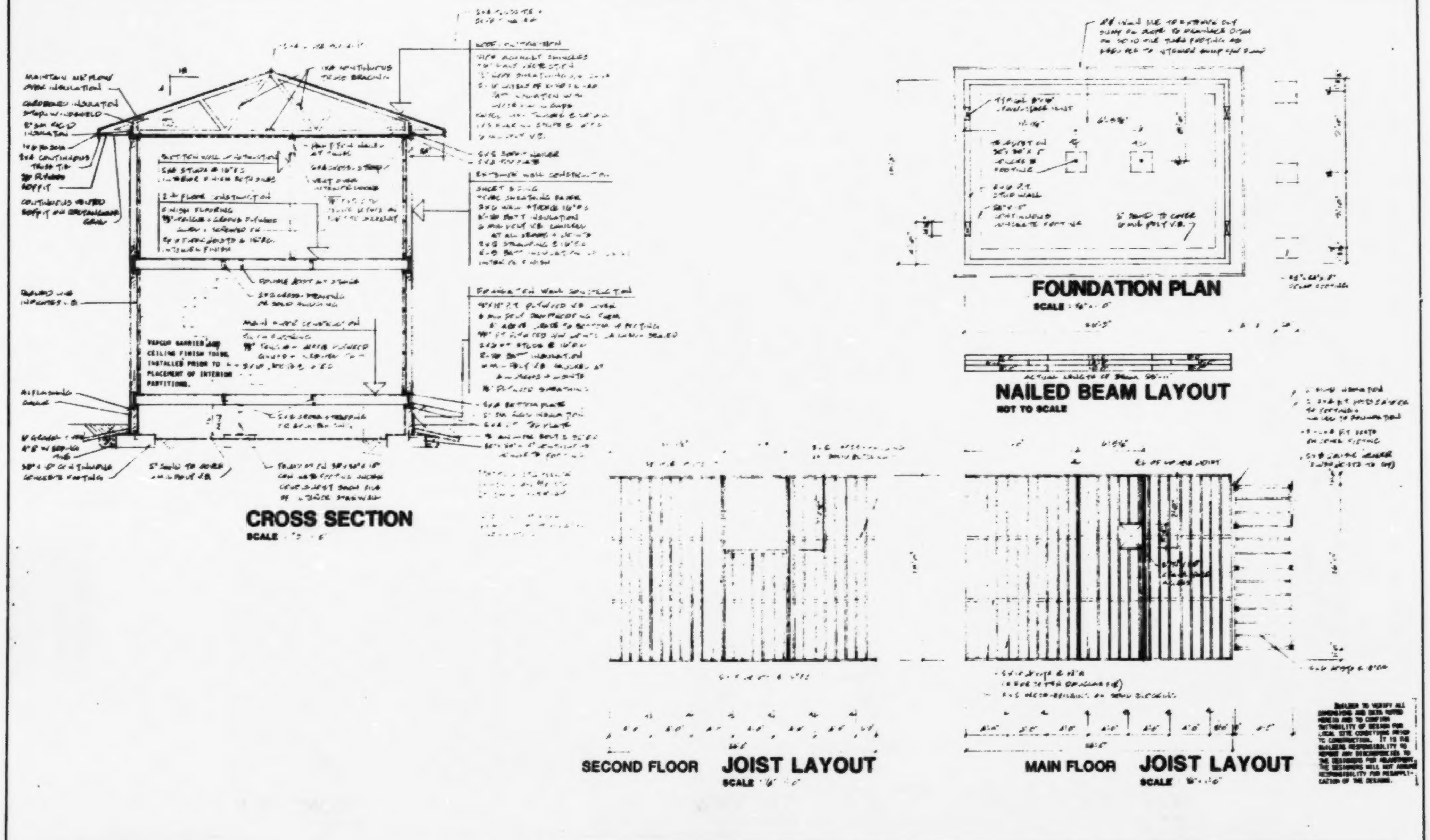
J1

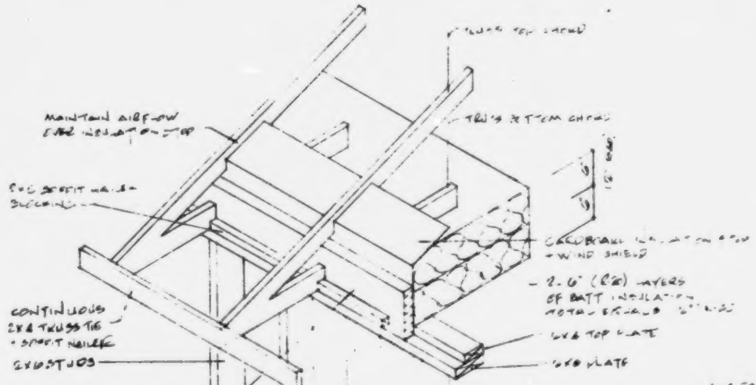

MAINTAIN AIR FLOW OVER INSULATION
CONTINUOUS VENTED SOFFIT ON OVERHANG
VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.
DOUBLE JOIST AT STAIRS
CROSS SECTION
SCALE
FOUNDATION PLAN
SCALE
NAILED BEAM LAYOUT
NOT TO SCALE
SECOND FLOOR JOIST LAYOUT
SCALE
MAIN FLOOR JOIST LAYOUT
SCALE
BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

18x26 TWO STOREY
SECTION AND FOUNDATION

APPIN ASSOC. INC.

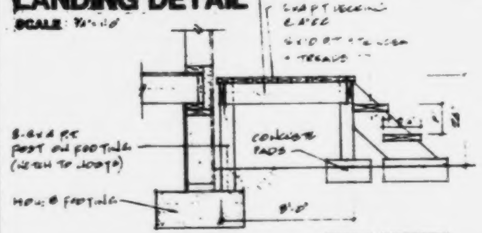
J2

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CERTIFY SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.


TRUSS TOP CHORD
MAINTAIN AIRFLOW OVER INSULATION TOP
TRUSS BOTTOM CHORD
2x6 SOFFIT NAILER BLOCKING
CARDBOARD INSULATION STOP + WIND SHIELD
2 - 6" (R-19) LAYERS OF BATT INSULATION
CONTINUOUS 2x4 TRUSS TIE + SOFFIT NAILER
2x6 TOP PLATE
2x6 STUDS
2x6 PLATE
2" RIGID INSULATION

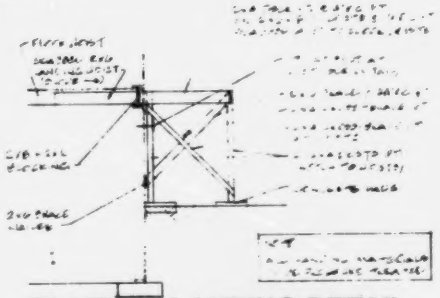
SOFFIT VENTING DETAIL

NOT TO SCALE


CONCRETE PADS
HOUSE FOOTING
8'-0"

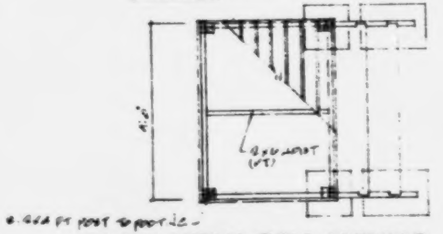
LANDING DETAIL

SCALE : 3/8"=1'-0"


FLOOR JOIST
2x6 + 2x6 BLOCKING
2x6 BRACE

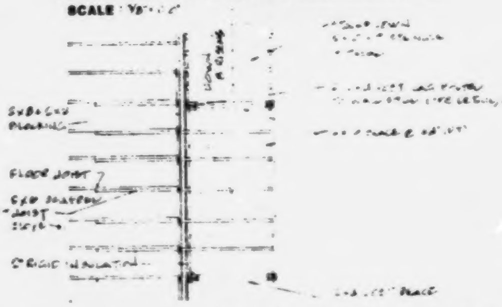
BI-LEVEL LANDING DETAIL

SCALE : 3/8"=1'-0"


2x6 JOIST (PT)

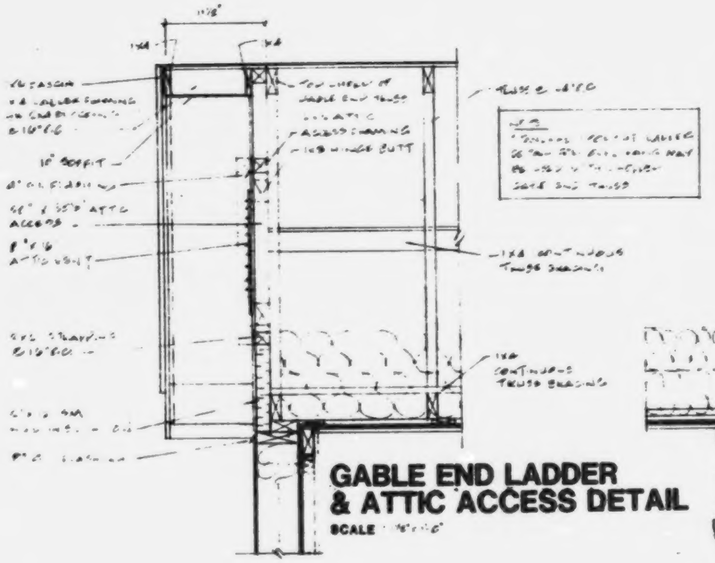
PLAN VIEW OF LANDING

SCALE : 3/8"=1'-0"


FLOOR JOIST
2" RIGID INSULATION

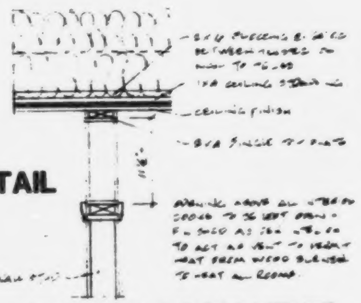
PLAN VIEW OF BI-LEVEL LANDING

SCALE : 3/8"=1'-0"


1x4
12" SOFFIT
ACCESS FRAMING
1x3 HINGE BUTT
ATTIC VENT
1x4 CONTINUOUS TRUSS BRACING
1x4 CONTINUOUS TRUSS BRACING

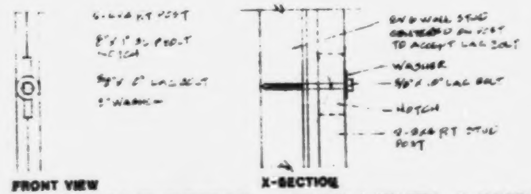
GABLE END LADDER & ATTIC ACCESS DETAIL

SCALE : 1/2"=1'-0"


1x4 CEILING STRAPPING
CEILING FINISH
2x4 SINGLE TOP PLATE
WALL STUD

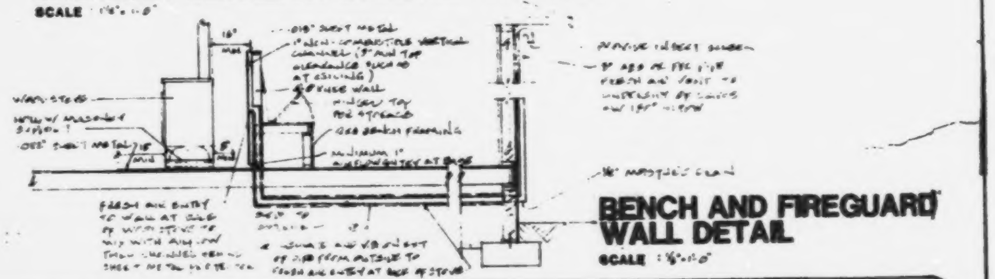
INTERIOR ROOM VENT

SCALE : 1½"=1'-0"


WASHER
NOTCH
FRONT VIEW
X-SECTION

LAG BOLT DETAIL AT BI-LEVEL LANDING

SCALE : 1½"=1'-0"


WOOD STOVE
SEE BENCH FRAMING

BENCH AND FIREGUARD WALL DETAIL

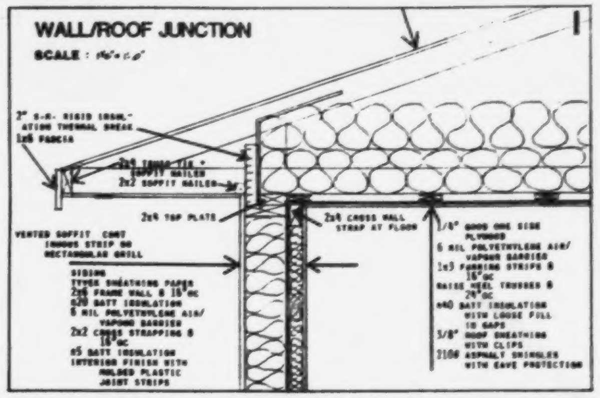
SCALE : ½"=1'-0"

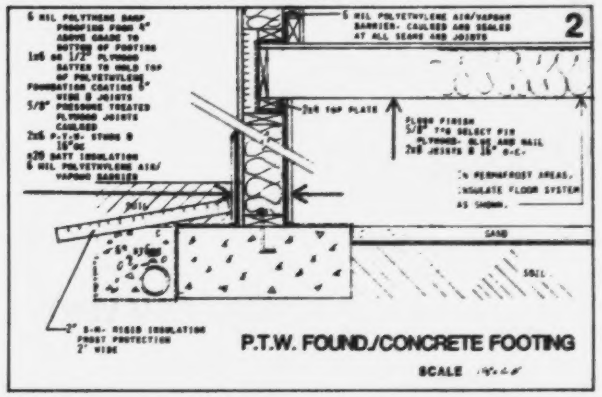
[illegible]

CONSTRUCTION DETAILS

APPIN ASSOC. INC.

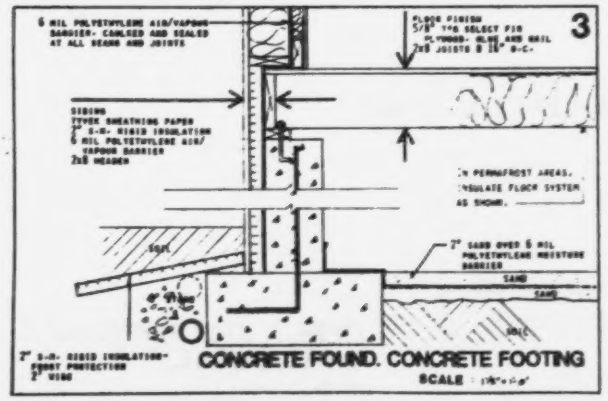
3


WALL/ROOF JUNCTION
SCALE : 1½"=1'-0"
1
2" S.R. RIGID INSUL-ATION THERMAL BREAK
1x6 FASCIA
2x4 TRUSS TIE + SOFFIT NAILER
2x2 SOFFIT NAILER
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONTINUOUS STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" OC
RAISE HEEL TRUSSES @ 24" OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION


2
6 MIL POLYTHENE DAMP PROOFING FROM 6" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTER TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
SAND
6" STONE
2" S.R. RIGID INSULATION FROST PROTECTION 2' WIDE

P.T.W. FOUND./CONCRETE FOOTING

SCALE : 1½"=1'-0"


3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
SIDING
TYVEK SHEATHING PAPER
2" S.R. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
2" S.R. RIGID INSULATION-FROST PROTECTION 2' WIDE

CONCRETE FOUND. CONCRETE FOOTING

SCALE : 1½"=1'-0"

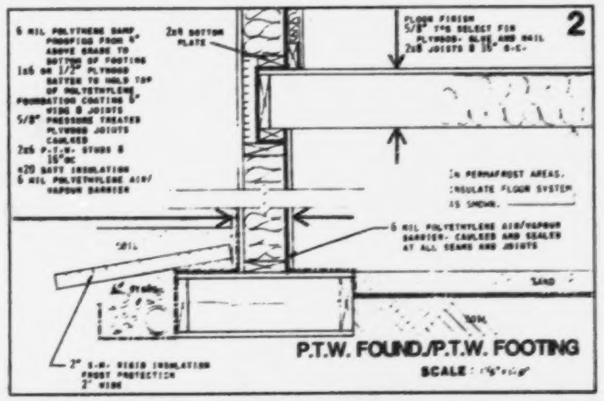
1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 x 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR THE JUNCTION BETWEEN THE FIRST FLOOR AND A PRESERVED WOOD FOUNDATION. AFTER THE FOUNDATION WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL, THE REMAINDER HANGS DOWN ON THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL IS PLACED ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

3 FRAME WALL OVERHANGS JOIST HEADER AND CONCRETE CRAWL SPACE WALL BY 2". 6 MIL POLY VAPOUR BARRIER RUNS UNDER BOTTOM PLATE OF FRAME WALL AND ON THE CRAWL SPACE WALL, TO THE FOOTING. 2" OF RIGID INSULATION IS PLACED OVER THE VAPOUR BARRIER. DO NOT INSULATE INSIDE OF JOIST HEADER. AT FOOTING, RIGID INSULATION IS EXTENDED HORIZONTALLY 2 FEET TO PROVIDE A THERMAL BREAK. GROUNDSHEET IN CRAWL SPACE IS REQUIRED FOR MOISTURE CONTROL. IT IS HELD IN PLACE AND PROTECTED BY A LAYER OF SAND OR FINE SOIL.

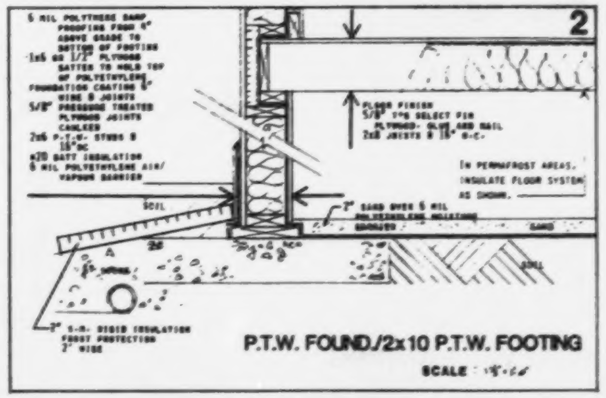
INSULATED CRAWL SPACE IS ONLY RECOMMENDED WHERE HOUSE IS LOCATED ON PERMAFROST. THE PLYWOOD FLOOR SHEATING SERVES AS THE FLOOR VAPOUR BARRIER. CAULK THE WALL VAPOUR BARRIER TO THE FLOOR SHEATING AND CAULK THE SEAMS BETWEEN THE SHEETS OF PLYWOOD. A 6 MIL POLY GROUNDSHEET IS LOCATED UNDER THE HOUSE AND PROTECTED WITH A LAYER OF SAND.

THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).


2
6 MIL POLYTHENE DAMP PROOFING FROM 6" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTER TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 BOTTOM PLATE
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SOIL
SAND
2" S.R. RIGID INSULATION FROST PROTECTION 2' WIDE

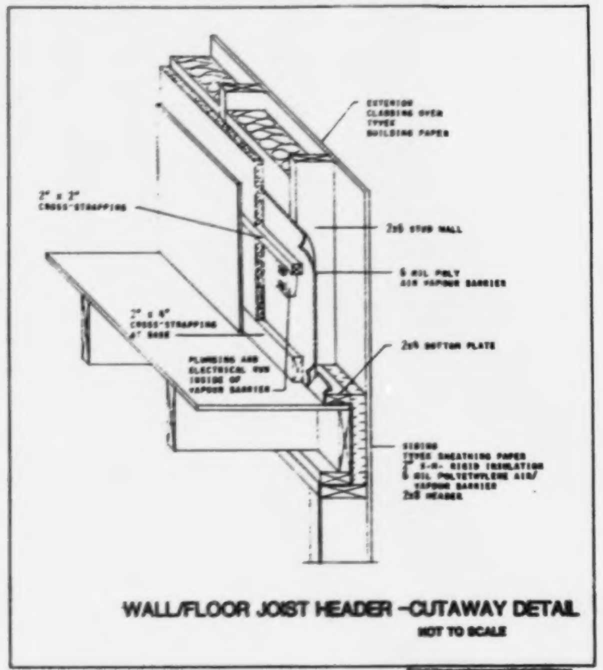
P.T.W. FOUND./P.T.W. FOOTING

SCALE : 1½"=1'-0"


2
6 MIL POLYTHENE DAMP PROOFING FROM 6" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTER TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
FLOOR FINISH 5/8" T+G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
2" S.R. RIGID INSULATION FROST PROTECTION 2' WIDE

P.T.W. FOUND./2x10 P.T.W. FOOTING

SCALE : 1½"=1'-0"

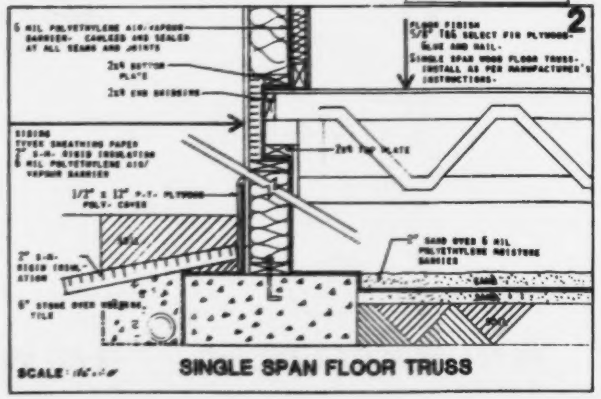

EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
2x4 BOTTOM PLATE
SIDING
TYVEK SHEATHING PAPER
2" S.R. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER

WALL/FLOOR JOIST HEADER –CUTAWAY DETAIL

NOT TO SCALE

NOTE: ALL FLOOR COVER CHANGED TO:

FLOOR FINISH
5/8" T+G SELECT FIR PLYWOOD OR 5/8" T+G STD. SPRUCE PLY. C/W 5/16" STD. PLY. UNDERLAY. GLUE + NAIL.
2x8 JOISTS @ 16" O.C.


2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
FLOOR FINISH 5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS. INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
SIDING
TYVEK SHEATHING PAPER
2" S.R. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P.T. PLYWOOD POLY. COVER
SOIL
2" S.R. RIGID INSULATION
6" STONE OVER WEEPING TILE
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND

SCALE : 1½"=1'-0"

SINGLE SPAN FLOOR TRUSS

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS ENCOUNTERED IN SPECIFIC REMOTE NORTHERN [illegible] COMMUNITIES WITH LIMITED ELECTRICAL AND OTHER SERVICES. IF THESE DESIGNS ARE USED WHERE DIFFERENT CONDITIONS EXIST, [illegible] MAY BE NECESSARY. FOR EXAMPLE, IF [illegible] THEN IT IS THE RESPONSIBILITY OF THE [illegible] TO MODIFY THE DESIGNS AS NECESSARY.

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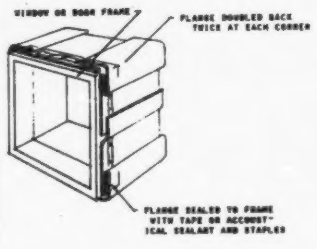
CONSTRUCTION & ENGINEERING DETAILS

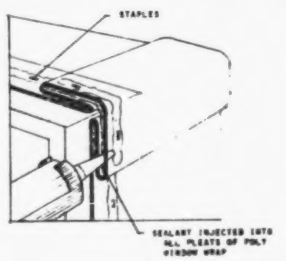
APPIN ASSOC. INC.
10-77 RUE EUGENIE
WPG. MAN.

4


WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACCOUSTICAL SEALANT AND STAPLES

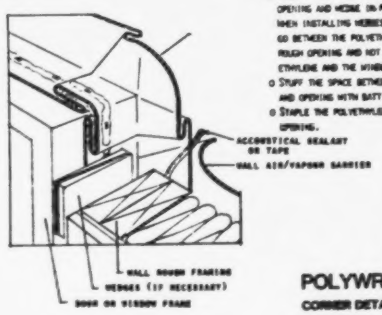
- o CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- o APPLY A BEAD OF ACOUSTICAL SEALANT TO THE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE
1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

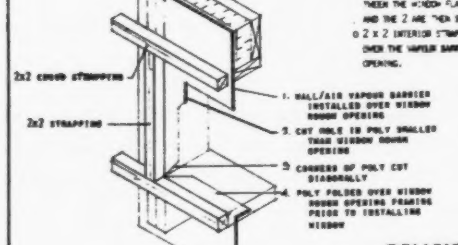
- o LAY THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- o AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE
2


ACCOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

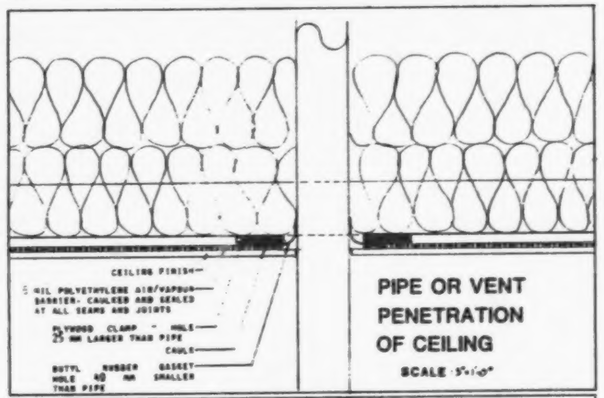
- o INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- o STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- o STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE
3

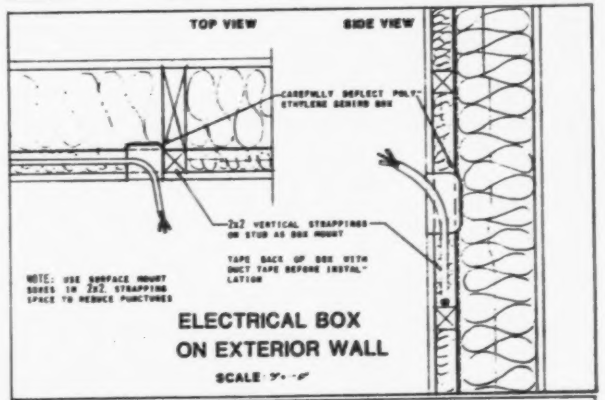

2x2 ROUGH STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

- o AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- o 2 x 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.

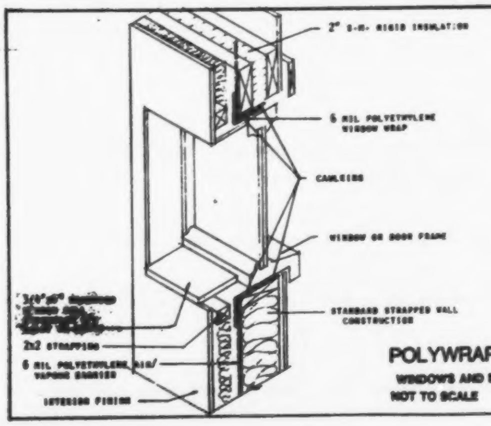
POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE
4


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 40 MM SMALLER THAN PIPE

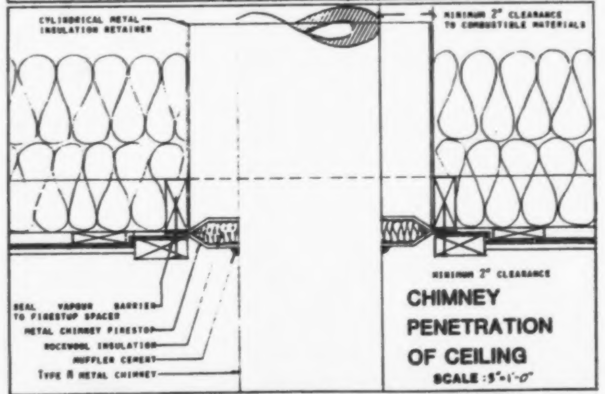
PIPE OR VENT PENETRATION OF CEILING
SCALE 5"=1'-0"


TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPINGS ON STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION
NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE 3"=1'-0"

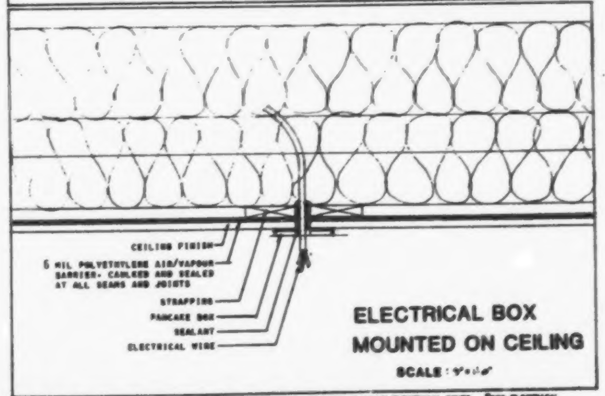

2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
3/4"x6" [illegible]
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE
5


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
MINIMUM 2" CLEARANCE
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY

CHIMNEY PENETRATION OF CEILING
SCALE : 5"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER, CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE : 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OR VOIDS IN INSULATION.

[illegible]

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPENCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

CONSTRUCTION & ENGINEERING DETAILS

UNIES ltd

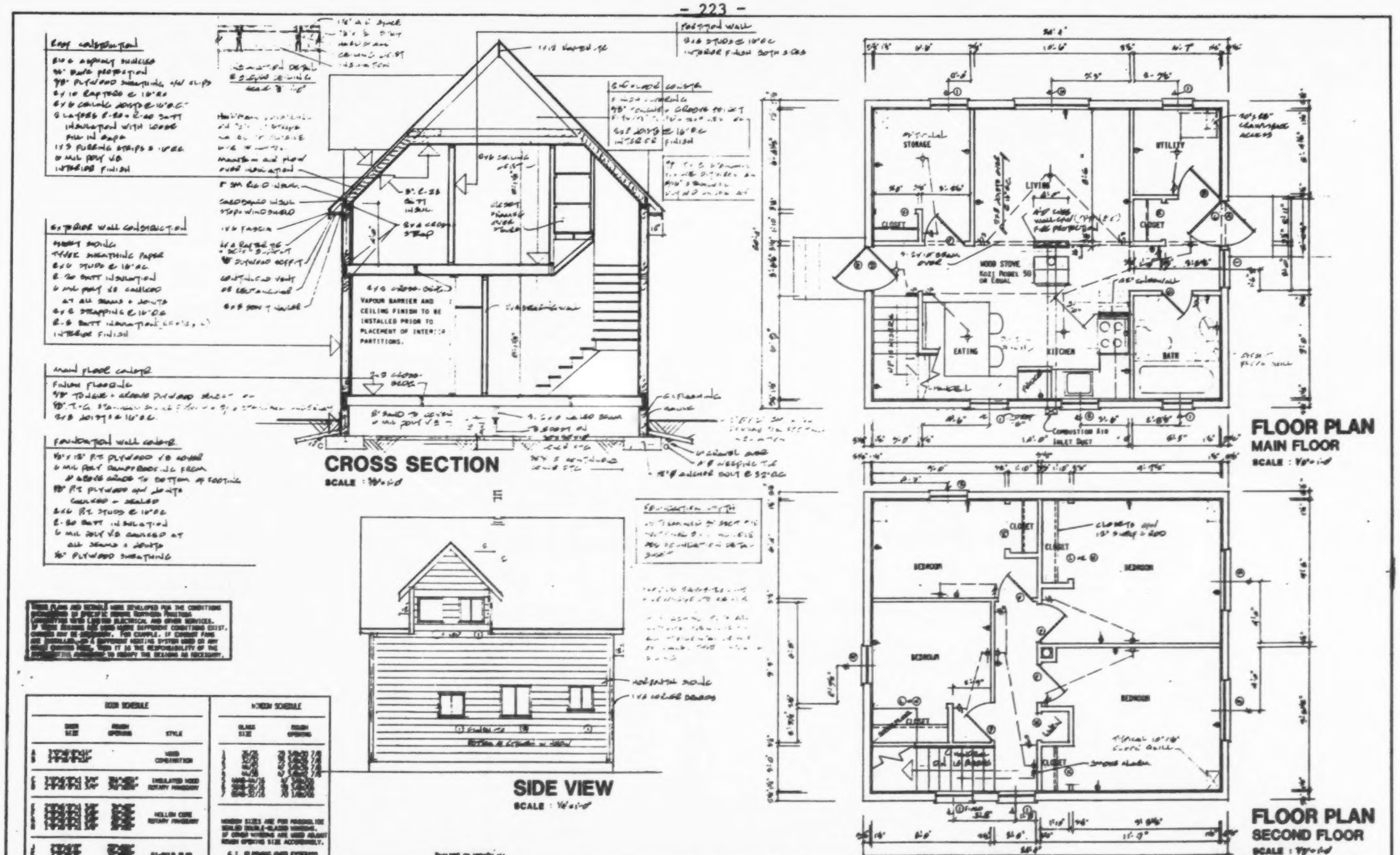
APPIN ASSOC. INC.
13-77 [illegible]
WPG. MAN.

5

5.4 20' x 24' (1-3/4 Storey/4 Bedroom) Design Features

Approximately 960 sq. ft. of useable floor area is allowed for this design. The design features are as follows:

- The 1-3/4 storey style of house allows for the use of 2" x 6" x 12' studs (cheaper than construction of a two storey house) while allowing more headroom than obtained in conventional 1-1/2 storey designs.
- The dining area (possibly a built-in unit) is situated under the stairs leading to the second floor.
- The plans show five bedrooms (four on second floor and one on main floor) but the elimination of the bedroom on the main floor would allow for a much larger living room for everyday activities.
- The bathroom is located next to the rear entrance.
- A vestibule entry can be accommodated through the addition of a door at the end of the short hallway leading to the main living area.
- The wood stove is centrally located on main floor, creating a visual separation between the living room and the kitchen/dining areas. As well, it is available for cooking.
- The utility storage room is located opposite the bathroom.
- Storage is also accommodated above staircase (accessible from bedroom).
- A secondary exit from the house has been provided at the base of the stairway.


Roof construction
210# asphalt shingles
36" eave protection
3/8" plywood sheathing c/w clips
2x10 rafters @ 16" o.c.
2x6 ceiling joists @ 16" o.c.
2 layers R-20 + R-20 batt insulation with loose fill in gaps
1x3 furring strips @ 16" o.c.
6 mil poly V.B.
interior finish
Exterior wall construction
Tyvek sheathing paper
2x6 studs @ 16" o.c.
R-20 batt insulation
6 mil poly V.B. caulked at all seams + joints
2x2 strapping @ 16" o.c.
R-8 batt insulation
interior finish
Main floor constr.
Finish flooring
5/8" tongue + groove plywood
2x8 joists @ 16" o.c.
Foundation wall constr.
1/2" x 12" P.T. plywood
6 mil poly dampproofing from 8" above grade to bottom of footing
5/8" P.T. plywood c/w joints caulked + sealed
2x6 P.T. studs @ 16" o.c.
R-20 batt insulation
6 mil poly V.B. caulked at all seams + joints
1/2" plywood sheathing
1x6 fascia
3/8" plywood soffit
continuous vent
VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.
CROSS SECTION
SCALE : 3/8"=1'-0"
SIDE VIEW
SCALE : 1/8"=1'-0"
DOOR SCHEDULE
WINDOW SCHEDULE
STORAGE
LIVING
UTILITY
CLOSET
WOOD STOVE
Kozi Model 50 or Equal
EATING
KITCHEN
BATH
COMBUSTION AIR INLET DUCT
FLOOR PLAN
MAIN FLOOR
SCALE : 3/8"=1'-0"
BEDROOM
CLOSET
BEDROOM
BEDROOM
BEDROOM
FLOOR PLAN
SECOND FLOOR
SCALE : 3/8"=1'-0"

20 x 24 1¾ OR 2 STOREY
4 BEDROOM

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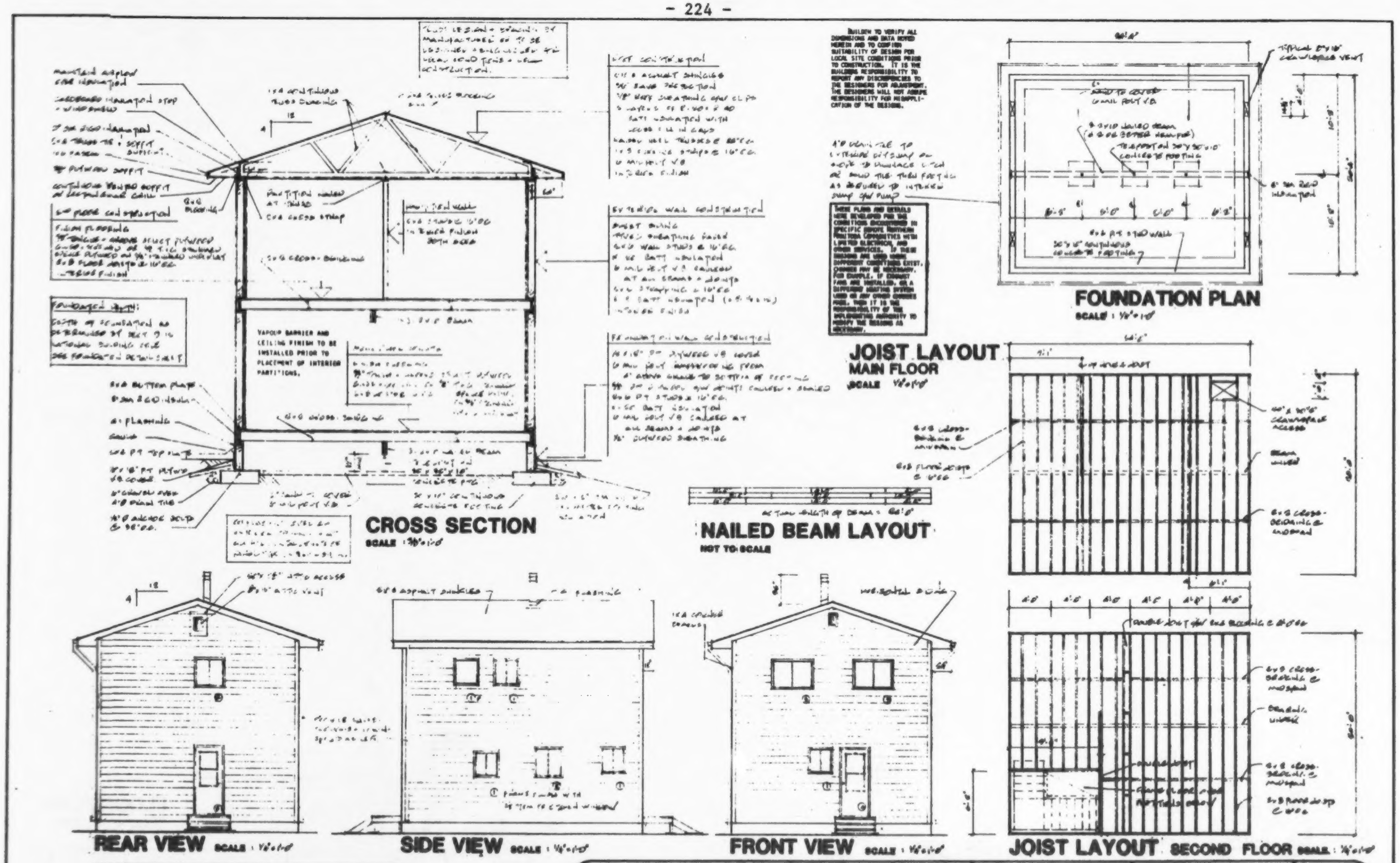
L1


CROSS SECTION
SCALE : 3/8"=1'-0"
FOUNDATION PLAN
SCALE : 1/8"=1'-0"
JOIST LAYOUT
MAIN FLOOR
SCALE 1/8"=1'-0"
NAILED BEAM LAYOUT
NOT TO SCALE
REAR VIEW SCALE : 1/8"=1'-0"
SIDE VIEW SCALE : 1/8"=1'-0"
FRONT VIEW SCALE : 1/8"=1'-0"
JOIST LAYOUT SECOND FLOOR SCALE : 1/8"=1'-0"
ASPHALT SHINGLES
ATTIC ACCESS
ATTIC VENT
CONCRETE FOOTING
BEAM

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS ENCOUNTERED IN SPECIFIC REMOTE NORTHERN MANITOBA COMMUNITIES WITH LIMITED ELECTRICAL AND OTHER SERVICES. IF THESE DESIGNS ARE USED WHERE DIFFERENT CONDITIONS EXIST, CHANGES MAY BE NECESSARY. FOR EXAMPLE, IF EXHAUST FANS ARE INSTALLED, OR A DIFFERENT HEATING SYSTEM USED OR ANY OTHER CHANGES MADE, THEN IT IS THE RESPONSIBILITY OF THE IMPLEMENTING AUTHORITY TO MODIFY THE DESIGNS AS NECESSARY.

VAPOUR BARRIER AND CEILING FINISH TO BE INSTALLED PRIOR TO PLACEMENT OF INTERIOR PARTITIONS.

EXTERIOR SIDING ALTERNATIVES ARE:

- [illegible]
- [illegible]
- [illegible] SIDING
- [illegible]

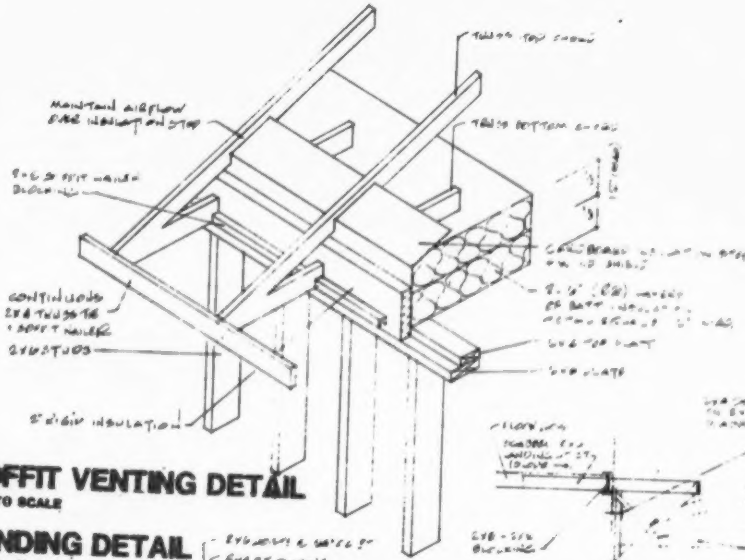
THE ADDITION OF 1 x 4 OR 2 x 2 HORIZONTAL STRAPPING TO THE EXTERIOR OF THE OUTSIDE WALLS WILL ACCOMMODATE LOCALLY SAWN BOARD-ON-BOARD SIDING.

20 x 24 1¾ OR 2 STOREY
SECTION,ELEV.,& FOUNDATION

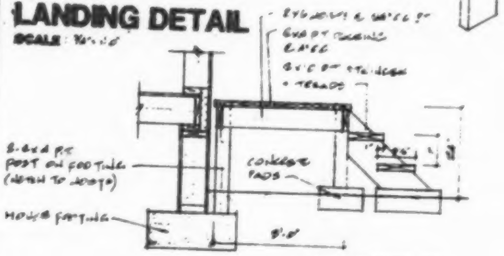
APPIN ASSOC. INC.

L2

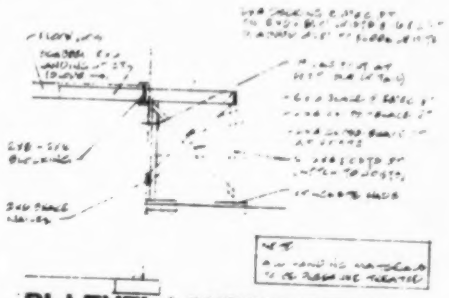
[illegible]


TRUSS TOP CHORD
MAINTAIN AIRFLOW EAVE INSULATION STOP
TRUSS BOTTOM CHORD
CONTINUOUS 2x4 TRUSS TIE + SOFFIT NAILER
2x6 STUDS
2" RIGID INSULATION
2x6 TOP PLATE
2x6 PLATE

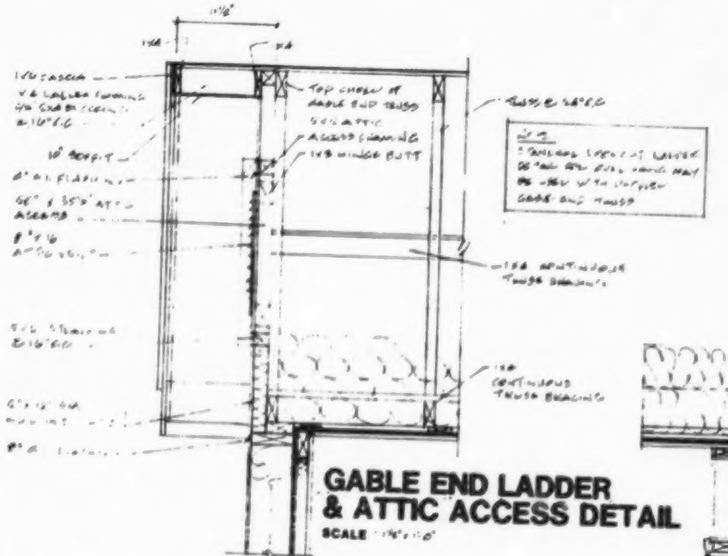
SOFFIT VENTING DETAIL
NOT TO SCALE


CONCRETE PADS
HOUSE FOOTING

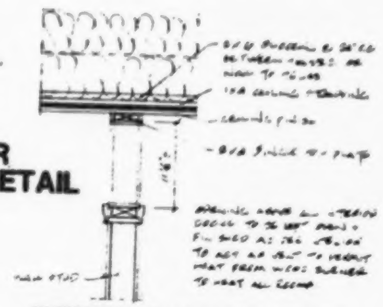
LANDING DETAIL
SCALE : 3/8"=1'-0"



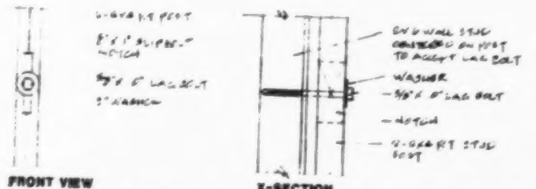
BI-LEVEL LANDING DETAIL
SCALE : 3/8"=1'-0"


1x4 FASCIA
TOP CHORD OF GABLE END TRUSS
SCUTTLE ATTIC
1x4 CONTINUOUS TRUSS BRACING

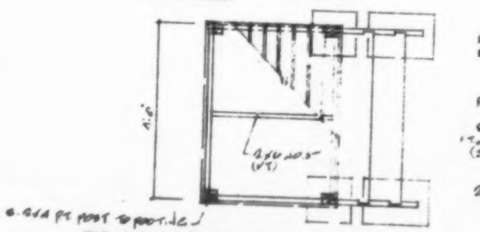
GABLE END LADDER & ATTIC ACCESS DETAIL
SCALE : 1/2"=1'-0"



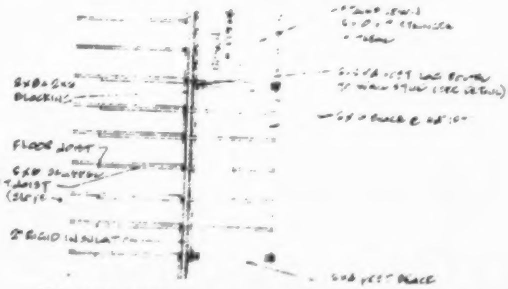
INTERIOR ROOM VENT
SCALE : 1/2"=1'-0"


FRONT VIEW
X-SECTION
WASHER
5/8" x 6" LAG BOLT
NOTCH

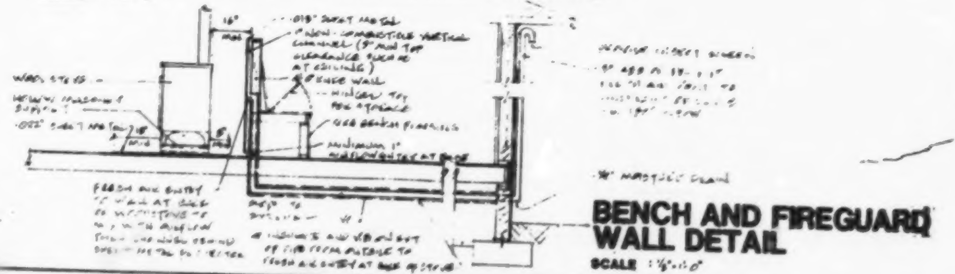
LAG BOLT DETAIL AT BI-LEVEL LANDING
SCALE : 1/2"=1'-0"



PLAN VIEW OF LANDING
SCALE : 3/8"=1'-0"


FLOOR JOIST
2" RIGID INSULATION

PLAN VIEW OF BI-LEVEL LANDING
SCALE : 3/8"=1'-0"


FRESH AIR ENTRY

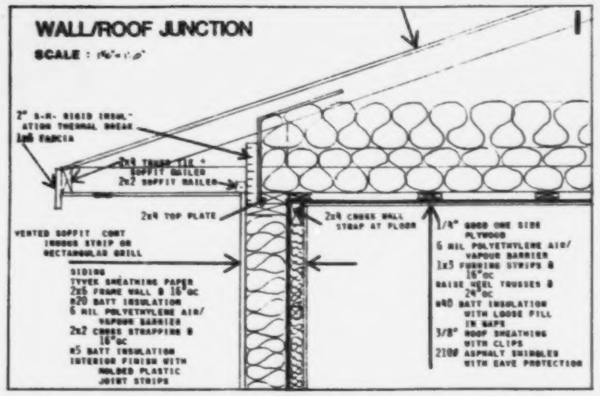
BENCH AND FIREGUARD WALL DETAIL
SCALE : 1/2"=1'-0"

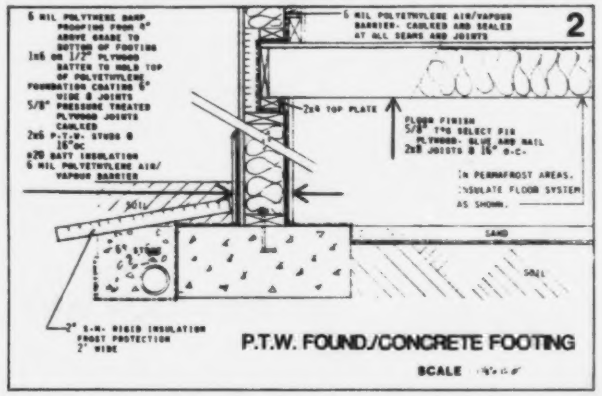
[illegible]

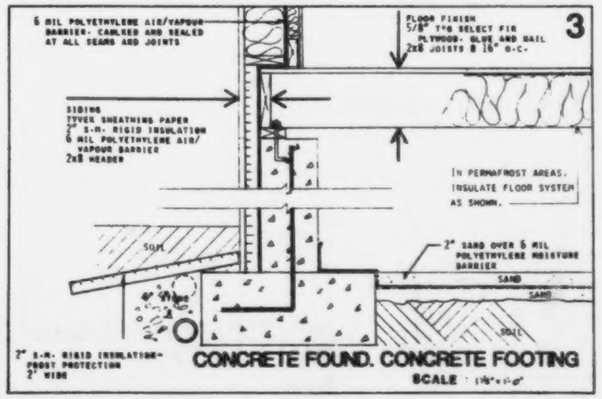
CONSTRUCTION DETAILS

APPIN ASSOC. INC.

3


WALL/ROOF JUNCTION
SCALE : 1½" = 1'-0"
1
2" S.M. RIGID INSULATION THERMAL BREAK
1x6 FASCIA
2x4 TRUSS TIE + SOFFIT NAILER
2x2 SOFFIT NAILER
2x4 TOP PLATE
2x4 CROSS WALL STRAP AT FLOOR
VENTED SOFFIT CONT INDUS STRIP OR RECTANGULAR GRILL
SIDING
TYVEK SHEATHING PAPER
2x6 FRAME WALL @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x2 CROSS STRAPPING @ 16" OC
R5 BATT INSULATION
INTERIOR FINISH WITH MOLDED PLASTIC JOINT STRIPS
1/4" GOOD ONE SIDE PLYWOOD
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
1x3 FURRING STRIPS @ 16" OC
RAISE HEEL TRUSSES @ 24" OC
R40 BATT INSULATION WITH LOOSE FILL IN GAPS
3/8" ROOF SHEATHING WITH CLIPS
210# ASPHALT SHINGLES WITH EAVE PROTECTION


2
6 MIL POLYTHENE DAMP PROOFING FROM 8" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 TOP PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
6" STONE
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE
P.T.W. FOUND./CONCRETE FOOTING
SCALE : 1½" = 1'-0"


3
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SAND
SOIL
6" STONE
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE
CONCRETE FOUND. CONCRETE FOOTING
SCALE : 1½" = 1'-0"

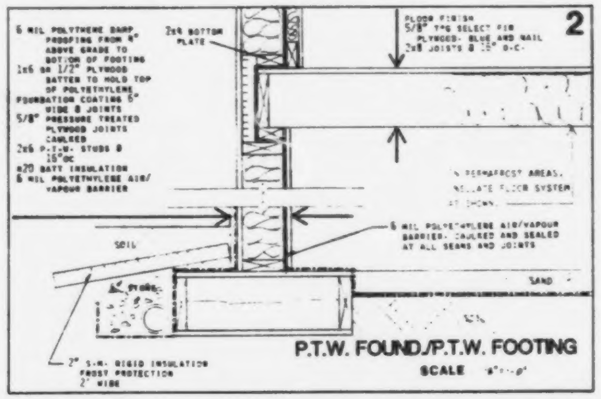
1 THE USE OF RAISED HEEL TRUSSES ALLOWS INCREASED LEVELS OF INSULATION IN THE CEILING ALONG THE OUTSIDE WALLS, REDUCING CONDENSATION PROBLEMS IN THIS AREA. THE INSULATION RETAINER AND WIND BREAK IS MADE OF CARDBOARD. IT IS STAPLED BETWEEN THE RAFTERS. IT PREVENTS WIND FROM BLOWING THROUGH THE INSULATION ALONG THE SOFFITS AND IT HOLDS THE INSULATION AWAY FROM THE ROOF SHEATING, ALLOWING AIR FLOW FOR ATTIC VENTILATION. THE 1 x 3 CEILING STRAPPING RETAINS THE ATTIC INSULATION DURING CONSTRUCTION AND PROVIDES A NAILING STRIP FOR THE CEILING FINISH.

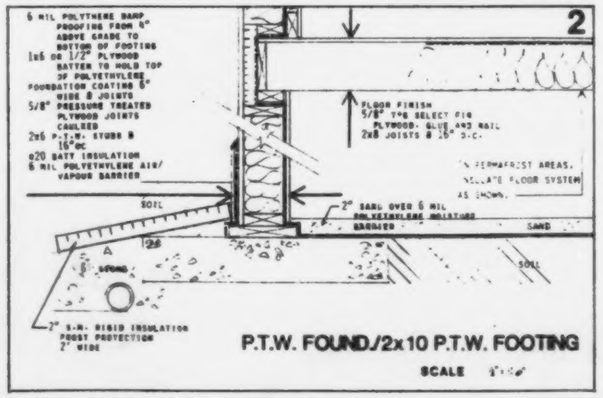
2 THIS DETAIL SHOWS VAPOUR BARRIER PLACEMENT FOR THE JUNCTION BETWEEN THE FIRST FLOOR AND A PRESERVED WOOD FOUNDATION. AFTER THE FOUNDATION WALL HAS BEEN CONSTRUCTED, A STRIP OF 6 MIL POLY TWO FEET WIDE IS PLACED OVER THE LOWER TOP PLATE. ABOUT 6 INCHES OF THE POLY HANGS DOWN THE INSIDE OF THE WALL. THE REMAINDER HANGS DOWN ON THE OUTSIDE OF THE WALL. THE UPPER TOP PLATE IS THEN INSTALLED, HOLDING THE POLY IN PLACE DURING CONSTRUCTION OF THE FLOOR ASSEMBLY. THE POLY STRIP ON THE OUTSIDE OF THE RIM JOIST OR JOIST HEADER IS WRAPPED AROUND THE RIM JOIST AND OVER THE FLOOR PRIOR TO ERECTION OF THE UPPER WALL. THE UPPER WALL IS PLACED ON THIS POLY STRIP. WHEN THE WALL VAPOUR BARRIERS ARE INSTALLED, CAULK THEM TO THE RIM JOIST VAPOUR BARRIER USING ACOUSTICAL SEALANT. DO NOT INSULATE THE SPACE INSIDE THE RIM JOIST.

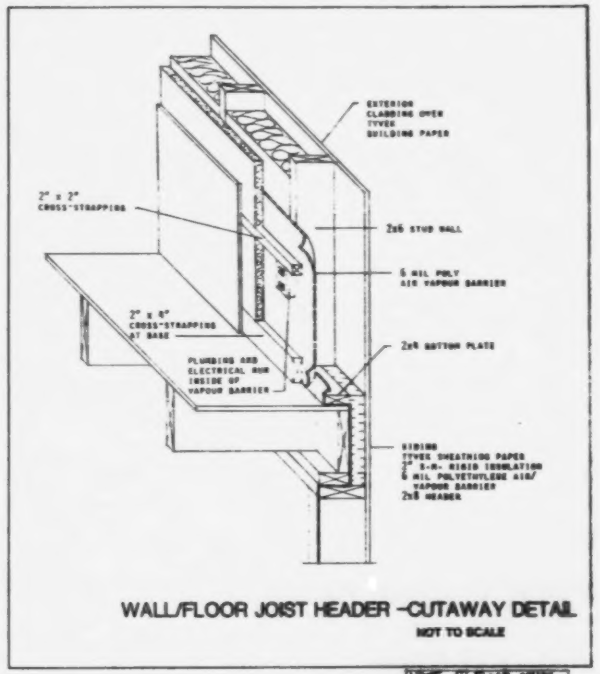
3 FRAME WALL OVERHANGS JOIST HEADER AND CONCRETE CRAWL SPACE WALL BY 2". 6 MIL POLY VAPOUR BARRIER RUNS UNDER BOTTOM PLATE OF FRAME WALL AND ON THE CRAWL SPACE WALL, TO THE FOOTING. 2" OF RIGID INSULATION IS PLACED OVER THE VAPOUR BARRIER. DO NOT INSULATE INSIDE OF JOIST HEADER. AT FOOTING, RIGID INSULATION IS EXTENDED HORIZONTALLY 2 FEET TO PROVIDE A THERMAL BREAK. GROUNDSHEET IN CRAWL SPACE IS REQUIRED FOR MOISTURE CONTROL. IT IS HELD IN PLACE AND PROTECTED BY A LAYER OF SAND OR FINE SOIL.

UNHEATED CRAWL SPACE IS ONLY RECOMMENDED WHERE HOUSE IS LOCATED ON PERMAFROST. THE PLYWOOD FLOOR SHEATING SERVES AS THE FLOOR VAPOUR BARRIER. CAULK THE WALL VAPOUR BARRIER TO THE FLOOR SHEATING AND CAULK THE SEAMS BETWEEN THE SHEETS OF PLYWOOD. A 6 MIL POLY GROUNDSHEET IS LOCATED UNDER THE HOUSE AND PROTECTED WITH A LAYER OF SAND.

THE MINIMUM DEPTH OF FOUNDATIONS SITED ON CLAYS OR SOILS NOT CLEARLY DEFINED SHALL BE 4 FEET UNLESS EXPERIENCE WITH LOCAL SOIL CONDITIONS SHOW THAT LESSER DEPTHS ARE SATISFACTORY. (SECTION 9.12 NATIONAL BUILDING CODE).

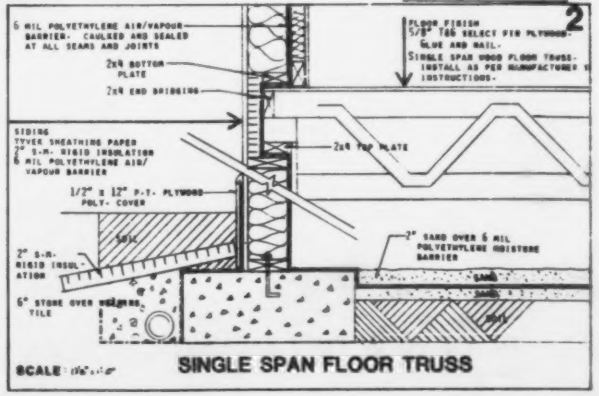

2
6 MIL POLYTHENE DAMP PROOFING FROM 8" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 BOTTOM PLATE
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
SOIL
6" STONE
SAND
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE
P.T.W. FOUND./P.T.W. FOOTING
SCALE 1" = 1'-0"


2
6 MIL POLYTHENE DAMP PROOFING FROM 4" ABOVE GRADE TO BOTTOM OF FOOTING
1x6 OR 1/2" PLYWOOD BATTEN TO HOLD TOP OF POLYETHYLENE
FOUNDATION COATING 6" WIDE @ JOINTS
5/8" PRESSURE TREATED PLYWOOD JOINTS CAULKED
2x6 P.T.W. STUDS @ 16" OC
R20 BATT INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL
2x8 JOISTS @ 16" O.C.
IN PERMAFROST AREAS. INSULATE FLOOR SYSTEM AS SHOWN.
SOIL
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
2x8
A
6" STONE
SOIL
2" S.M. RIGID INSULATION FROST PROTECTION 2' WIDE
P.T.W. FOUND./2x10 P.T.W. FOOTING
SCALE 1" = 1'-0"


EXTERIOR CLADDING OVER TYVEK BUILDING PAPER
2" x 2" CROSS-STRAPPING
2x6 STUD WALL
6 MIL POLY AIR VAPOUR BARRIER
2" x 4" CROSS-STRAPPING AT BASE
PLUMBING AND ELECTRICAL RUN INSIDE OF VAPOUR BARRIER
2x4 BOTTOM PLATE
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x8 HEADER
WALL/FLOOR JOIST HEADER -CUTAWAY DETAIL
NOT TO SCALE

NOTE: ALL FLOOR COVER CHANGED TO:

FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD OR 5/8" T&G STD. SPRUCE PLY. C/W 5/16" STD. PLY. UNDERLAY. GLUE & NAIL
2x8 JOISTS @ 16" O.C.


2
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER. CAULKED AND SEALED AT ALL SEAMS AND JOINTS
2x4 BOTTOM PLATE
2x4 END BRIDGING
FLOOR FINISH
5/8" T&G SELECT FIR PLYWOOD. GLUE AND NAIL.
SINGLE SPAN WOOD FLOOR TRUSS. INSTALL AS PER MANUFACTURER'S INSTRUCTIONS.
SIDING
TYVEK SHEATHING PAPER
2" S.M. RIGID INSULATION
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
2x4 TOP PLATE
1/2" x 12" P.T. PLYWOOD POLY. COVER
SOIL
2" S.M. RIGID INSULATION
6" STONE OVER WEEPING TILE
2" SAND OVER 6 MIL POLYETHYLENE MOISTURE BARRIER
SAND
SAND
SOIL
SCALE : 1½" = 1'-0"
SINGLE SPAN FLOOR TRUSS

THESE PLANS AND DETAILS WERE DEVELOPED FOR THE CONDITIONS ENCOUNTERED IN SPECIFIC REMOTE NORTHERN [illegible] COMMUNITIES WITH LIMITED ELECTRICAL AND OTHER SERVICES. IF THESE DRAWINGS ARE USED WHERE DIFFERENT CONDITIONS EXIST, CHANGES MAY BE NECESSARY. FOR EXAMPLE, IF EXHAUST FANS ARE INSTALLED, OR A DIFFERENT HEATING SYSTEM USED OR ANY OTHER CHANGES ARISE, THEN IT IS THE RESPONSIBILITY OF THE [illegible] AUTHORITY TO MODIFY THE DESIGNS AS NECESSARY.

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPENCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGNS.

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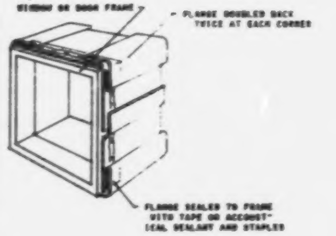
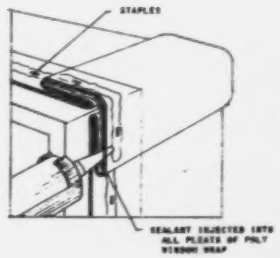

WINDOW OR DOOR FRAME
FLANGE DOUBLED BACK TWICE AT EACH CORNER
FLANGE SEALED TO FRAME WITH TAPE OR ACOUSTICAL SEALANT AND STAPLED

- CUT A 24 INCH WIDE STRIP OF 6 MIL POLYETHYLENE. IT SHOULD BE LONG ENOUGH TO GO AROUND THE WINDOW WITH ABOUT 20 INCHES EXTRA.
- APPLY A BEAD OF ACOUSTICAL SEALANT TO THE SIDE OF THE WOOD WINDOW FRAME. THE BEAD MUST BE LOCATED JUST OUTSIDE OF ANY JAMB EXTENSION TO ENSURE ANY JOINTS BETWEEN THE WINDOW FRAME AND JAMB EXTENSIONS ARE SEALED.

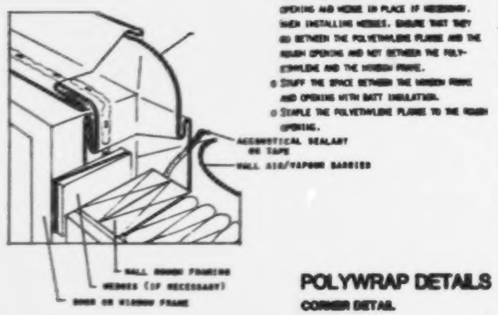
POLYWRAP DETAILS
WRAPPING THE WINDOW FRAME
NOT TO SCALE 1


STAPLES
SEALANT INJECTED INTO ALL PLEATS OF POLY WINDOW WRAP

- [illegible] THE POLYETHYLENE STRIP OVER THE CAULKING BEAD AND STAPLE IT TO THE FRAME THROUGH THE CAULKING BEAD.
- AT THE CORNERS PLACE A PLEAT IN THE POLYETHYLENE ON BOTH SIDES OF THE CORNER. STAPLE THE PLEATS TO THE WOOD FRAME AND INJECT ACOUSTICAL SEALANT TO SEAL THE PLEATS. THE PLEATS ALLOW THE POLYETHYLENE FLANGE TO FOLD BACK AT THE CORNERS AND SEAL AGAINST THE WALL AIR BARRIER. CONTINUE THIS PROCESS AROUND THE FRAME AND JOIN THE POLYETHYLENE STRIP TO ITSELF WITH A BEAD OF ACOUSTICAL SEALANT AND STAPLES.

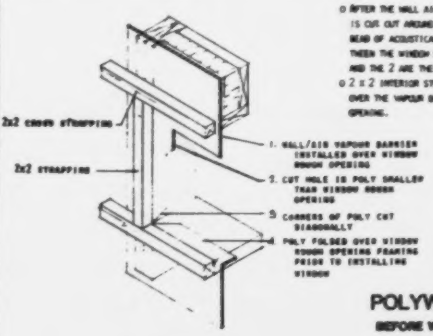
POLYWRAP DETAILS
SEALING THE PLEATS
NOT TO SCALE 2

- INSERT THE WINDOW FRAME IN THE ROUGH OPENING AND WEDGE IN PLACE IF NECESSARY. WHEN INSTALLING WEDGES, ENSURE THAT THEY GO BETWEEN THE POLYETHYLENE FLANGE AND THE ROUGH OPENING AND NOT BETWEEN THE POLYETHYLENE AND THE WINDOW FRAME.
- STUFF THE SPACE BETWEEN THE WINDOW FRAME AND OPENING WITH BATT INSULATION.
- STAPLE THE POLYETHYLENE FLANGE TO THE ROUGH OPENING.

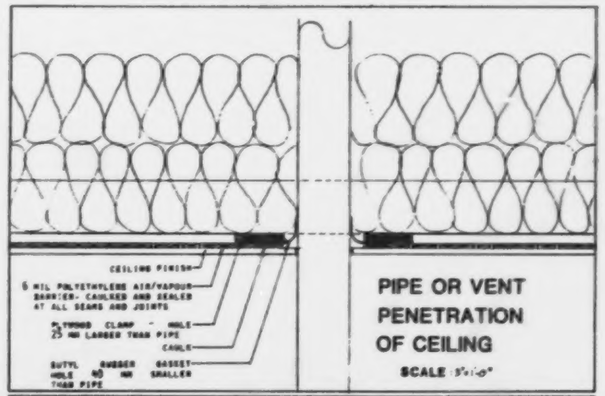

ACOUSTICAL SEALANT OR TAPE
WALL AIR/VAPOUR BARRIER
WALL ROUGH FRAMING
WEDGES (IF NECESSARY)
DOOR OR WINDOW FRAME

POLYWRAP DETAILS
CORNER DETAIL
NOT TO SCALE 3

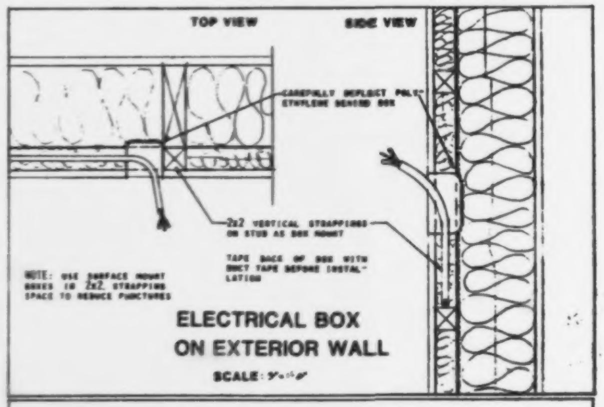
- AFTER THE WALL AIR BARRIER IS APPLIED, IT IS CUT OUT AROUND THE WINDOW OPENING. A BEAD OF ACOUSTICAL SEALANT IS APPLIED BETWEEN THE WINDOW FLANGE AND WALL AIR BARRIER AND THE 2 ARE THEN STAPLED TOGETHER.
- 2 x 2 INTERIOR STRAPPING IS THEN APPLIED OVER THE VAPOUR BARRIERS AROUND THE ROUGH OPENING.


2x2 CROSS STRAPPING
2x2 STRAPPING
1. WALL/AIR VAPOUR BARRIER INSTALLED OVER WINDOW ROUGH OPENING
2. CUT HOLE IN POLY SMALLER THAN WINDOW ROUGH OPENING
3. CORNERS OF POLY CUT DIAGONALLY
4. POLY FOLDED OVER WINDOW ROUGH OPENING FRAMING PRIOR TO INSTALLING WINDOW

POLYWRAP DETAILS
BEFORE WINDOW INSTALLATION
NOT TO SCALE 4

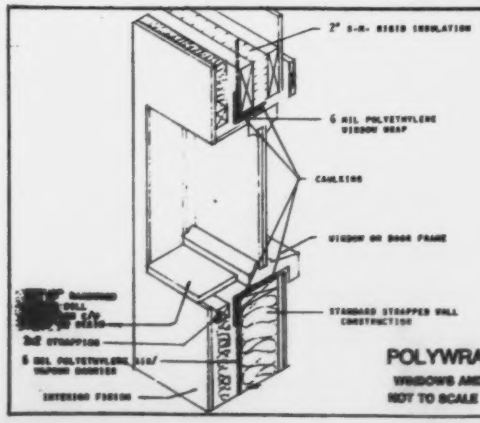

CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
PLYWOOD CLAMP - HOLE 25 MM LARGER THAN PIPE
CAULK
BUTYL RUBBER GASKET HOLE 40 MM SMALLER THAN PIPE

PIPE OR VENT PENETRATION OF CEILING
SCALE 3"=1'-0"

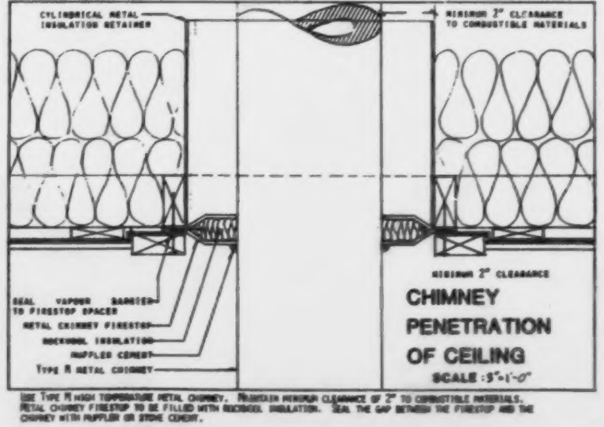

TOP VIEW
SIDE VIEW
CAREFULLY DEFLECT POLYETHYLENE BEHIND BOX
2x2 VERTICAL STRAPPINGS ON STUD AS BOX MOUNT
TAPE BACK OF BOX WITH DUCT TAPE BEFORE INSTALLATION

NOTE: USE SURFACE MOUNT BOXES IN 2x2 STRAPPING SPACE TO REDUCE PUNCTURES

ELECTRICAL BOX ON EXTERIOR WALL
SCALE: 3"=1'-0"

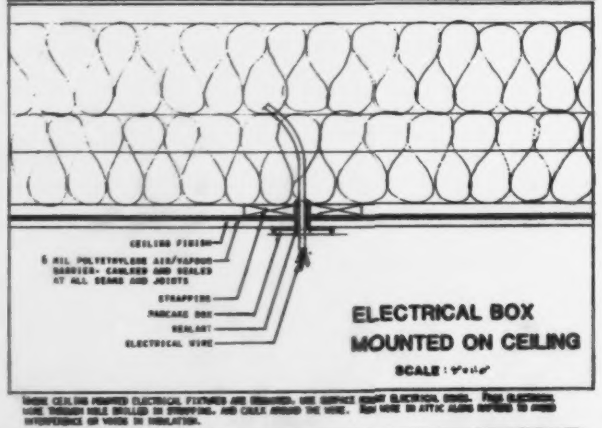

2" S.R. RIGID INSULATION
6 MIL POLYETHYLENE WINDOW WRAP
CAULKING
WINDOW OR DOOR FRAME
STANDARD STRAPPED WALL CONSTRUCTION
[illegible]
2x2 STRAPPING
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER
INTERIOR FINISH

POLYWRAP DETAILS
WINDOWS AND DOORS
NOT TO SCALE 5


CYLINDRICAL METAL INSULATION RETAINER
MINIMUM 2" CLEARANCE TO COMBUSTIBLE MATERIALS
SEAL VAPOUR BARRIER TO FIRESTOP SPACER
METAL CHIMNEY FIRESTOP
ROCKWOOL INSULATION
MUFFLER CEMENT
TYPE A METAL CHIMNEY
MINIMUM 2" CLEARANCE

CHIMNEY PENETRATION OF CEILING
SCALE: 3"=1'-0"

USE TYPE A HIGH TEMPERATURE METAL CHIMNEY. MAINTAIN MINIMUM CLEARANCE OF 2" TO COMBUSTIBLE MATERIALS. METAL CHIMNEY FIRESTOP TO BE FILLED WITH ROCKWOOL INSULATION. SEAL THE GAP BETWEEN THE FIRESTOP AND THE CHIMNEY WITH MUFFLER OR STOVE CEMENT.


CEILING FINISH
6 MIL POLYETHYLENE AIR/VAPOUR BARRIER- CAULKED AND SEALED AT ALL SEAMS AND JOINTS
STRAPPING
PANCAKE BOX
SEALANT
ELECTRICAL WIRE

ELECTRICAL BOX MOUNTED ON CEILING
SCALE: 3"=1'-0"

WHERE CEILING MOUNTED ELECTRICAL FIXTURES ARE REQUIRED, USE SURFACE MOUNT ELECTRICAL BOXES. FEED ELECTRICAL WIRE THROUGH HOLE DRILLED IN STRAPPING, AND CAULK AROUND THE WIRE. RUN WIRE IN ATTIC ALONG RAFTERS TO AVOID INTERFERENCE OF VOIDS IN INSULATION.

[illegible]

BUILDER TO VERIFY ALL DIMENSIONS AND DATA NOTED HEREIN AND TO CONFIRM SUITABILITY OF DESIGN FOR LOCAL SITE CONDITIONS PRIOR TO CONSTRUCTION. IT IS THE BUILDERS RESPONSIBILITY TO REPORT ANY DISCREPANCIES TO THE DESIGNERS FOR ADJUSTMENT. THE DESIGNERS WILL NOT ASSUME RESPONSIBILITY FOR MISAPPLICATION OF THE DESIGN.

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VI. PHASE I PROJECT CONCLUSIONS AND OBSERVATIONS ON POSSIBLE PHASE II STRATEGIES

6.1 Conclusions: Good Housing Starts with Good House Designs

This design exercise was an attempt to develop energy efficient housing in a fashion which maximized community participation in the design process. The designs are novel, yet they use conventional building techniques and materials.

The goals of the design exercise were to design housing that:

- would meet community needs.
- was energy efficient
- could be built by local people
- was within the housing budget guidelines of DIAND and CMHC
- would last longer than conventional designs.

The designs developed by the Design Team go a long way to meet all of these goals. The goals of housing designed to the Arctic Housing Standards and being within existing budgets could not be met simultaneously because there was not enough money in the housing budget to pay for all the energy conserving features required by the standards. The Design Team did make the housing as energy efficient as possible given the existing housing budgets.

6.2 An Outline for Phase II

It was clear that the interest of the communities and Indian people in general in Phase I was so that Phase II - The Demonstration Phase - could be undertaken. While the Indian organizations must decide for themselves how Phase II should be done, the second phase could have the following components:

1. **A training component** which would train local people with building skills in the techniques of energy efficient housing.
2. **A demonstration house building component** which would permit the construction of all the house designs - a few in each remote community - as a way to prove their worth. The houses would be funded from regular housing budgets with the incremental costs of conservation items being paid under the Phase II program. The houses would also be monitored over a few winters to see how well they performed. They would be repaired or altered as necessary.
3. **A public participation and reporting component** that would ensure that the communities were fully informed about the project as it progressed and that a proper record of the project was available once the project was finished.

The communities mentioned often that the emphasis in Phase II should be on training local people to build their own housing. They recognize that as Indian self-government gradually becomes a reality over the next few years, they must have the skills to build and maintain the housing themselves. A multi-year demonstration project of the type described above would help to promote self-reliance in northern communities.

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"The Economic rate for water delivery and sewage pumpout in N.W.T. communities is approximately 6 to 9¢/gallon."

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APPENDIX I

Background Review Stage Trip Report
MKO Energy Efficient Housing Design Project
December 6 and 7, 1984

John Hockman and Doug Branscombe of Appin Solar Associates and Gary Proskiw and Bert Phillips of UNIES Ltd. made the Background Review Stage trip during the week of December 3, 1984. The purpose of the trip was to identify and discuss problems with current housing and construction practices in the north. Specifically, meetings with the Chiefs and councils in two communities, Tadoule Lake and Brochet, were arranged. Input from members of the native communities in the study is considered to be an essential part of any successful native housing program.

Our itinerary was to fly to Thompson Wednesday evening, December 5. On Thursday morning we were scheduled to fly to Tadoule Lake where we would meet with the Chief and his council, overnight, and then fly to Brochet for a meeting on Friday. We would return to Thompson on Friday in time to catch a return flight to Winnipeg.

Tadoule Lake - December 6, 1984

We flew into Tadoule with Len's Flying Service on an Islander. Chief Peter Yassy was contacted and a meeting was arranged. The meeting was attended by the Chief, Horace the band carpenter and four councilors. Much of the discussion centered on the fact that the band had opted to satisfy the current backlog of housing needs by using their housing allotment to build many small (20 x 24) houses rather than the minimum number of standard houses. Because of their size many of the problems experienced with larger housing, such as poor heat distribution and differential movement are not problems with the housing in Tadoule. Good quality wood heaters are used in the housing, and as a result, in ten years there has not been a single house lost to fire.

After the meeting Horace escorted us to a couple of houses to show us the layout and construction they were using. Sam Bussidor, a local stone carver showed us the partially completed craft hall that the band was building. It is a log structure measuring about 24 x 40 feet, made from eight foot sections of local logs. Funding is currently being sought to complete construction.

We overnighted in the Tadoule Nursing Station. The evening and following morning were spent walking through the community and photographing the various types of housing that show the evolution of the community (log houses, 14 x 20 bungalows and now 20 x 24 bungalows).

Friday, December 7

The weather closed in overnight and our charter out to Brochet was unable to pick us up until late morning. Bad weather over Brochet meant we could not fly there and so we returned to Thompson. In Thompson we found out that Chief Philip Michelle of Brochet was also in Thompson, unable to return to Brochet due to the weather. We contacted him and arranged a meeting with him at the MKO offices in Thompson.

In attendance at that meeting was Chief Philip Michelle and two other band members from Brochet and Louis Wolverine, the KTC housing officer. A keen interest was expressed in alternative housing styles and in energy efficient house construction. Because of a frustrated attempt at constructing a 1½ storey house last summer, training and site supervison was seen as an essential requirement if new construction styles or techniques are to be attempted again by the Indians in Brochet.

We returned to Winnipeg by PWA on Friday evening.

Summary

Both meetings were considered to contribute significantly to our understanding of northern housing and its current design needs and financial constraints. There is a strong interest in upgrading the quality of construction, in building energy efficient house designs and in trying alternative house styles.

APPENDIX II

Preliminary Design Trip Report Stage
MKO Energy Efficient House Design Project
February 19 to 21, 1985

John Hockman of Appin Solar Associates and Bert Phillips of UNIES Ltd. travelled to Tadoule Lake, Lac Brochet, Brochet and Pukatawagan during the week of February 18, 1985. The purpose of the trip was to show the councils of the four noted communities the preliminary house designs developed for MKO's "Designs for Energy Efficient Housing in Manitoba's Remote Communities, Phase I". The meetings were opened with a brief summary of the objectives of this project and the work done to date. The band councils all expressed concern about house designs, about funding and training to help implement any new housing designs. Some asked specific questions about Phase II. In response to this we noted that the MKO was currently preparing a proposal for Phase II, the implementation of the Phase I work. The Phase II proposal would request funding to cover the extra costs (over the standard housing allowance) for demonstration houses in the communities and funding to train the band building crews in the techniques and concepts needed for different house styles and the new energy efficient features of the demonstration houses.

The bands all raised two concerns about Phase II. First there was a concern as to the adequacy of the extra funds. They would like the demonstration houses to be a fully funded, that is extra houses. Secondly, the bands all felt that the training component was most important. They expressed a sincere desire to have a training program that would help the builders "get it right" and thus avoid the frustrations and disappointments of unsuccessful construction efforts.

Finally, a letter listing the house plans was handed out to those in the meetings. The attendants were asked to note which house plans they favoured, which plans they disliked and make comments and recommendations.

Minutes were taken and comments recorded, as well as some more subjective indications of the participants reactions to our presentations (such as facial expressions).

At the conclusion of the meetings, the bands were given a copy of the Background Review Report and three copies of the Executive Summary. The following is a summary of our meetings.

Tadoule Lake - February 19, 1985

We flew into Tadoule with Len's Flying Service on the Islander. Wayne Roberts the DIAND housing officer and Denis the new DIAND Regional Engineer accompanied us. In attendance at the meeting were Tom, Joseph Duck, John Chickee, Stephen, and Wayne and Denis from DIAND, Thompson. Chief Peter Yassy was on business in Thompson. The meeting was held in the band offices in the early afternoon.

General comments:

- Privacy is important
- Like bathroom door at the exit
- Like "air lock" entries
- Suggest a hood over the stove with pipes to bedrooms to improve heat circulation

- Would like to see a 24' x 28' 3 bedroom bungalow design
- 3 would sacrifice some living room for larger bedrooms while Stephen would prefer a larger living room
- The 18' x 26' bilevel was the favourite of all the two level houses
- The modified A frame was not popular. The roof was seen to be too big and it looked funny. It was thought to be suitable for a band hall.

The council members did not sign and return the letters outlining the favoured designs. They indicated that they would respond once their Chief returned and was briefed on our presentation.

Lac Brochet - February 20, 1985

We flew into Lac Brochet with Northwinds on a Seneca with Wayne Roberts of DIAND. We had a late morning meeting in the band offices. In attendance were Chief Jerome Denechezhe, Julien, Adam Malge, Simon Samual (carpenter), William D. and Pat Hyslop an elder (speaks both Cree and Dene), as well as Wayne.

General comments:

- The trade off between living space, bedrooms and storage space was seen as an individual preference. Most families would prefer more living space.
- The housing-needs backlog meant this band, like Tadoule, built small houses. In the near term, small houses will continue to be prevalent for this reason.
- The bilevels were well accepted. Some band members have seen them in Wollaston Lake, Saskatchewan.
- The A frame house got smiles, but they said if it was inexpensive, they would try it out.
- There was a concern over fire escapes from the two level houses. Exits and stairs directly from the upper level were requested.
- Training of their builders was seen as an important part of Phase II.
- The designs favoured were the bungalows and bilevels.

Four members signed and returned letters checking preferred plans #1, 2, 3, 5, 6 and 7.

Brochet - February 20, 1985

After our meeting in Lac Brochet we flew to Brochet for an afternoon meeting. Northwinds replaced the Seneca with a Navaho, as the Seneca had an engine malfunction on the first leg of the trip. We met in the later part of the afternoon in the home of Chief Philip Michelle. Also in attendance were Alfred Bighetty, Morris, Gordon Halkelt and Wayne Roberts of DIAND.

General comments:

- Alfred Bighetty took a four-day course in EE housing sponsored by the KTC in Thompson.
- In reviewing plans #1 and 2 they felt the housing committee should be consulted with respect to the trade off between indoor utility rooms and larger living rooms.

- The 18' x 26' bilevel was a popular design, especially with the low walls at the entrance (i.e. open plans).
- The two story gambrel roof (#8) was favoured because of the amount of room in it.
- They would like a four bedroom house plan for their larger families.
- They would try the A frame if it gave affordable space.
- In general the Brochet band indicated it was willing to try any housing concept that allowed them to build bigger or more spacious housing within a given budget.

The chief and two others signed the letter and expressed interest in plans #1, 2, 3, 4, 5, 6, and 8.

Pukatawagan - February 21, 1985

Hockman and Phillips flew into Pukatawagan on a Northwinds Cessna 180 on skis. Poor weather in Thompson delayed our take-off by four hours so we had to settle for an afternoon meeting instead of the 10 meeting previously arranged. The meeting was held in the chief's office in the band hall. In attendance were Chief Pascall Bighetty, Cornelius Bighetty (band staff resident), Solomon Linklatter and Freda Caribou (secretary).

General comments:

- The attendants said they would like to get copies of our plans for the 1985 construction season as they might build one or more "experimental" houses. They have been trying different house styles in their regular housing program.
- There was a concern about only one door in plan #2.
- The corridors in plan #4 were seen as problems with respect to heat flow.
- Privacy is not a particular concern in house designs. Increased living space has a higher priority.
- Solomon suggested moving the bathroom door on plan #3 closer to the outside door.
- Soil and drainage conditions make below grade living spaces questionable here. Pascall has a bilevel and has had a problem with water in the lower level. They don't want sunken housing.
- They suggested flipping the bilevels and surface mounting them.
- The built in nook in plan #7 got positive nods.
- When we discussed two storeys, the response was positive.
- Of 1 1/2 and 1 3/4 storey plans Pascall noted they have some in Pukatawagan but "People don't build them anymore, I guess they didn't like them". The steep roof was a concern to the carpenters - especially if winter repairs were needed.
- Plan #8 two storey "get prices on that one". They requested a price comparison between #6 and #8.
- Plan #9 "would be like living in a tent" (Soloman), "not here" (Pascall)

The chief and two attendants signed the letters indicating they would like some bungalows with alot of open living area. Plans 1, 2, 4, 5 and 6 (as two storeys, not bilevels) were favoured and #8 would be considered if the price is right.

Summary

Variations in bungalows (24 x 28 - 3 BR, 24 x 32, 24 x 36) ranging from lots of small rooms to lots of open areas should be developed. The bilevels should be developed both as bilevels and as two storeys with various floor plans. The two storey house (16 x 28) and the A frame would be used in some places if the price was right. The steep roofed houses, in particular house #10 were not popular concepts.

Overall the trip was extremely positive and the response we received from all the bands was very encouraging.

February 22, 1985,
Bert Phillips, P.Eng.,
UNIES Ltd.

BROCHET

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H OX6

From: Barren Lands Band
Brochet
Manitoba

Date: 20/02/85

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design
1✓	24' x 28' bungalow - Plan A
2✓	24' x 28' bungalow - Plan B
3✓	24' x 36' bungalow - Plan A
4✓	24' x 36' bungalow - Plan B
5✓	24' x 32' bi-level
6✓	18' x 26' bi-level
7	20' x 24' 1 3/4 or 2-storey
8✓	16' x 28' 2-storey
9	20' x 30' A-frame
10	26' x 26' 1½-storey.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed)

LAC BROCHET

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H 0X6

From: Chief
Northlands Band
LAC BROCHET

Date: Feb 20/85

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design
1	24' x 28' bungalow - Plan A ✓
2	24' x 28' bungalow - Plan B ✓
3	24' x 36' bungalow - Plan A
4	24' x 36' bungalow - Plan B
5	24' x 32' bi-level ✓
6	18' x 26' bi-level ✓
7	20' x 24' 1 3/4 or 2-storey
8	16' x 28' 2-storey
9	20' x 30' A-frame
10	26' x 26' 1½-storey.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed)

LAC BROCHET

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H 0X6

From: Simeon Samuel
LAC Brochet

Date: Feb 20/2/85

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design
1	24' x 28' bungalow - Plan A ✓
2	24' x 28' bungalow - Plan B ✓
3	24' x 36' bungalow - Plan A ✓
4	24' x 36' bungalow - Plan B
5	24' x 32' bi-level
6	18' x 26' bi-level ✓
7	20' x 24' 1 3/4 or 2-storey ✓
8	16' x 28' 2-storey
9	20' x 30' A-frame
10	26' x 26' 1½-storey.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed)

LAC BROCHET

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H OX6

From: [illegible]

Date: [illegible]

LAC BRECHET

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design
1	24' x 28' bungalow - Plan A
[✓ 2]	24' x 28' bungalow - Plan B
3	24' x 36' bungalow - Plan A
4	24' x 36' bungalow - Plan B
[✓ 5]	24' x 32' bi-level
[✓ 6]	18' x 26' bi-level
7	20' x 24' 1 3/4 or 2-storey
8	16' x 28' 2-storey
9	20' x 30' A-frame
10	26' x 26' 1½-storey.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed) [illegible]

LAC BROCHET

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H OX6

From: [illegible]
Brochet

Date: [illegible]

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design
1	24' x 28' bungalow - Plan A
[✓ 2]	24' x 28' bungalow - Plan B
3	24' x 36' bungalow - Plan A
4	24' x 36' bungalow - Plan B
5	24' x 32' bi-level
[✓ 6]	18' x 26' bi-level
7	20' x 24' 1 3/4 or 2-storey
8	16' x 28' 2-storey
9	20' x 30' A-frame
10	26' x 26' 1½-storey.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed) [illegible]

PUKATAWACAN

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H 0X6

From: [illegible]
[illegible]
[illegible]

Date: [illegible]

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design	[illegible] -10
1	24' x 28' bungalow - Plan A	
2	24' x 28' bungalow - Plan B	
3	24' x 36' bungalow - Plan A	
4	24' x 36' bungalow - Plan B	✓ [illegible]
5	24' x 32' bi-level	[illegible] (SIZE 9)
6	18' x 26' bi-level	[illegible] SIZE.
7	20' x 24' 1 3/4 or 2-storey	NOT APPLICABLE
8	16' x 28' 2-storey	(2) [illegible] COST [illegible]
9	20' x 30' A-frame	[illegible]
10	26' x 26' 1½-storey.	[illegible] APPLICABLE.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed) Pascall J Bighetty

PUKATAWACAN

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H 0X6

From: [illegible]
[illegible]
[illegible]

Date: [illegible]

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design
1	24' x 28' bungalow - Plan A
2	24' x 28' bungalow - Plan B
3	24' x 36' bungalow - Plan A
4	24' x 36' bungalow - Plan B
5	24' x 32' bi-level
6	18' x 26' bi-level
7	20' x 24' 1 3/4 or 2-storey
8	16' x 28' 2-storey
9	20' x 30' A-frame
10	26' x 26' 1½-storey.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed)

PUKATAWAGAN

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H 0X6

From:

Date:

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design
1	24' x 28' bungalow - Plan A
2	24' x 28' bungalow - Plan B
3	24' x 36' bungalow - Plan A
4	24' x 36' bungalow - Plan B
5	24' x 32' bi-level
6	18' x 26' bi-level
7	20' x 24' 1 3/4 or 2-storey
8	16' x 28' 2-storey
9	20' x 30' A-frame
10	26' x 26' 1½-storey.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed)

TADOULE LAKE

To: Appin Solar Associates, Inc.
13-77 Rue Eugenie
Winnipeg, Man.
R2H 0X6

From: Ft. Churchill Indian Band
Tadoule Lake Man
R0B 2C0

Date: Feb 21/85

Dear Sirs,

We have to-day reviewed the house designs which you presented for our consideration under the terms of your proposal for Designs for Energy-Efficient Housing in Manitoba's Remote Communities.

Having reviewed the designs, we are of the opinion that the designs we checked below would be acceptable for the need of the people of this community:

Number	House Design
1	24' x 28' bungalow - Plan A
2	24' x 28' bungalow - Plan B
3	24' x 36' bungalow - Plan A
4	24' x 36' bungalow - Plan B
5	24' x 32' bi-level
[✓ 6]	18' x 26' bi-level
7	20' x 24' 1 3/4 or 2-storey
8	16' x 28' 2-storey
9	20' x 30' A-frame
10	26' x 26' 1½-storey.

In our opinion you have successfully completed Stage II, the Preliminary Design Stage, of your contract as outlined in the proposal referred to above.

Yours truly,

(Signed) A.C. Joe Thorassie
Steve Thorassie
Thomas Duck

APPENDIX III

MKO Energy Efficient House Design Project

Final Community Visit

Trip Report - March 19 and 20, 1985

John Hockman and Bert Phillips flew to Thompson on Monday, March 18, 1985 to make the final community visits. Although four communities were to have been visited, Chief Peter Yassy of Tadoule Lake told us that he and his council would not have time to meet with us anytime during the week, because they were involved in their winter Carnival. The trip itinerary was Brochet, Tuesday morning, March 19, Lac Brochet Tuesday afternoon and Pukatawagan on Wednesday morning. Wednesday afternoon we were scheduled to visit the DIAND and MKO office in Thompson before returning to Winnipeg. The purpose of the trip was to present the final floor plans and some of the proposed design features to the bands. For this purpose, drawings showing floor plans, cross sections and elevations were presented to the bands, for their own use. Architectural models of the 18 by 26 bilevels were left with the bands. We also took half-scale wall and roof sections along to illustrate the construction, insulation and vapour barrier details proposed.

Tuesday, March 19

We chartered a Cessna 206 from Len's Flying Service and departed the Thompson Airport at around 8:45 a.m. We arrived in Brochet shortly after 10:00 a.m. We were given a ride halfway to the Indian settlement and walked the rest of the way to the Band Offices. The Chief and council were just arriving at the Offices to prepare to meet the Regional Government Manager, Mr. Campbell, who was expected shortly. We were told we had until the R.G.M. arrived to make our presentation, then we would have to be excused. About 10:30 we started our presentation. Present were Chief Philip Michelle, Gordon Halkett, Alfred Bighetty and Adolf Bighetty. The drawings and wall sections were well received. John reviewed the plans with those present and Philip Michelle brought up Phase II. He has been in contact with Joe Guy Wood who is heading the Island Lake Tribal Council's efforts to proceed with Phase II. Philip asked us to contact Rene Rocher to express his strong interest in the project. He said we should tell Rene that he will contact him as soon as he gets to a good telephone. John promised to forward copies of the plans to McMunn Yates so that the band members could get prices for any of the new floor plans.

We had completed our presentation and discussions on Phase II when the R.G.M. and his entourage arrived. We returned to our plane and flew to Lac Brochet, leaving the plans on the wall and a model of the 18' x 26' bilevel for the community.

In Lac Brochet, we had to locate the Chief and some of the council members before we could make our presentation. None the less, our presentation began around 1:30 p.m. In attendance were Chief Jerome Denechezhe, the band carpenter Simon Samual, Adam Nalge and William Denechezhe.

The Chief stated they did not know what the 1985 housing allowance would be and so have not been able to identify the numbers or sizes of houses they will build this year. There was some discussion about windows. The band recognizes that the problems with windows in their houses are related to installation, and not the windows themselves. The windows currently used do not frost over in the winter.

The band liked the bilevels during the last visit but this time indicated there was a problem with crawl spaces flooding in the community. Local ground conditions indicate this should not be a problem if the houses are properly landscaped, but it appears that the two storey 18 x 26 (inverted bilevel plans) would be more acceptable here.

Chief Jerome again expressed his concern about getting training in Phase II. His continual emphasis on training indicates it is a high priority item for his band. In a twist to funding for training, an employment and immigration officer from The Pas was in Lac Brochet at the same time as us. He indicated to John that with Limestone proceeding, there would be an abundance of training funds available for programs teaching Northeners the skills needed for the limestone projects - such as carpentry.

Wednesday, March 20

A blizzard which passed from Pukatawagan in the morning to Thompson in the afternoon prevented us from going into Pukatawagan on Wednesday. We were told by the Chief that he could not see us on Thursday because the band was meeting all day with the R.C.M. With regrets we decided to cancel all plans to visit Pukatawagan this time. We went to the DIAND office in Thompson and met with Denis McKinty, the Regional Engineer. We left him copies of the plans and architectural models for delivery into Pukatawagan and Tadoule Lake. He indicated he would give the package for Tadoule to Wayne Roberts who is scheduled to visit there next week. Louis Young, who works out of the Thompson DIAND office with the band at Pukatawagan, would be asked to carry the materials to that band. We showed Denis the model wall sections and told him they would be at the MKO if Wayne wished to see or use them.

At the MKO office we gave Karen, the bookkeepper, the model wall sections and she gave us a letter of transmittal for them. She shyly informed us that the MKO did not have money for us at this time but should have in April.

Although we were only able to meet with two of the four bands this trip, our experience with those two bands was very positive. In addition to winding up the job, we need to contact Rene Rocher to relate Philip Michelle's message, send McMunn Yates copies of the drawings so they may discuss them with the bands and contact Wayne Roberts and Louis Young regarding the packages we wish them to deliver for us.

Bert Phillips
March 21, 1985